Province of British Columbia
Ministry of Energy, Mines and
Petroleum Resources
Hon. Jack Davis, Minister

MINERAL RESOURCES DIVISION
Geological Survey Branch

PRODUCING AND DEVELOPING THERMAL COAL PROPERTIES IN BRITISH COLUMBIA

By A. Matheson

OPEN FILE 1988-23

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90-06509/

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Canadian Cataloguing in Publication Data
Matheson, A.
Producing and developing thermal coal properties in British Columbia

(Open file, ISSN 0835-3530 ; 1988-23)

Bibliography: p.
ISBN 0-7718-8686-1

1. Bituminous coal - British Columbia - Thermal properties.
2. Coal mines and mining - British Columbia.
I. British Columbia. Geological Survey Branch. II. Title.
III. Series: Open file (British Columbia. Geological Survey Branch) ; 1988-23.

HD9554.C33B775 1988 338.2'724'09711 C88-092189-7

Open file reports are preliminary
and may not conform to editorial
standards applied to other publications
of the British Columbia Geological
Survey Branch

VICTORIA
BRITISH COLUMBIA
CANADA

January 1989

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INTRODUCTION

Following the Industrial Revolution coal became the major source of energy until the early part of the 20th century, when its importance declined as a result of the increase in use of abundant and inexpensive petroleum and natural gas. In recent years, however, the rising cost of petroleum has encouraged a return to the use of thermal coal and emphasized the necessity to avoid too great a dependency on any one source of fuel, particularly in view of the vagaries of present-day pricing. The diminishing supplies of petroleum and natural gas, the unstable political situation in the Middle East (source of over 60 per cent of the world's petroleum reserves) and the vast resources of coal throughout the world will ultimately force industry to become more dependent on coal and other alternative sources of energy.

The variability in rank of British Columbia coals allows the resource to meet a large spectrum of market demands. The coals vary from lignite at Hat Creek to anthracite in the Groundhog basin. The lignite at Hat Creek has undergone tests for atmospheric fluidized bed combustion and integrated coal gasification combined cycle for thermal power generation. Hat Creek has not

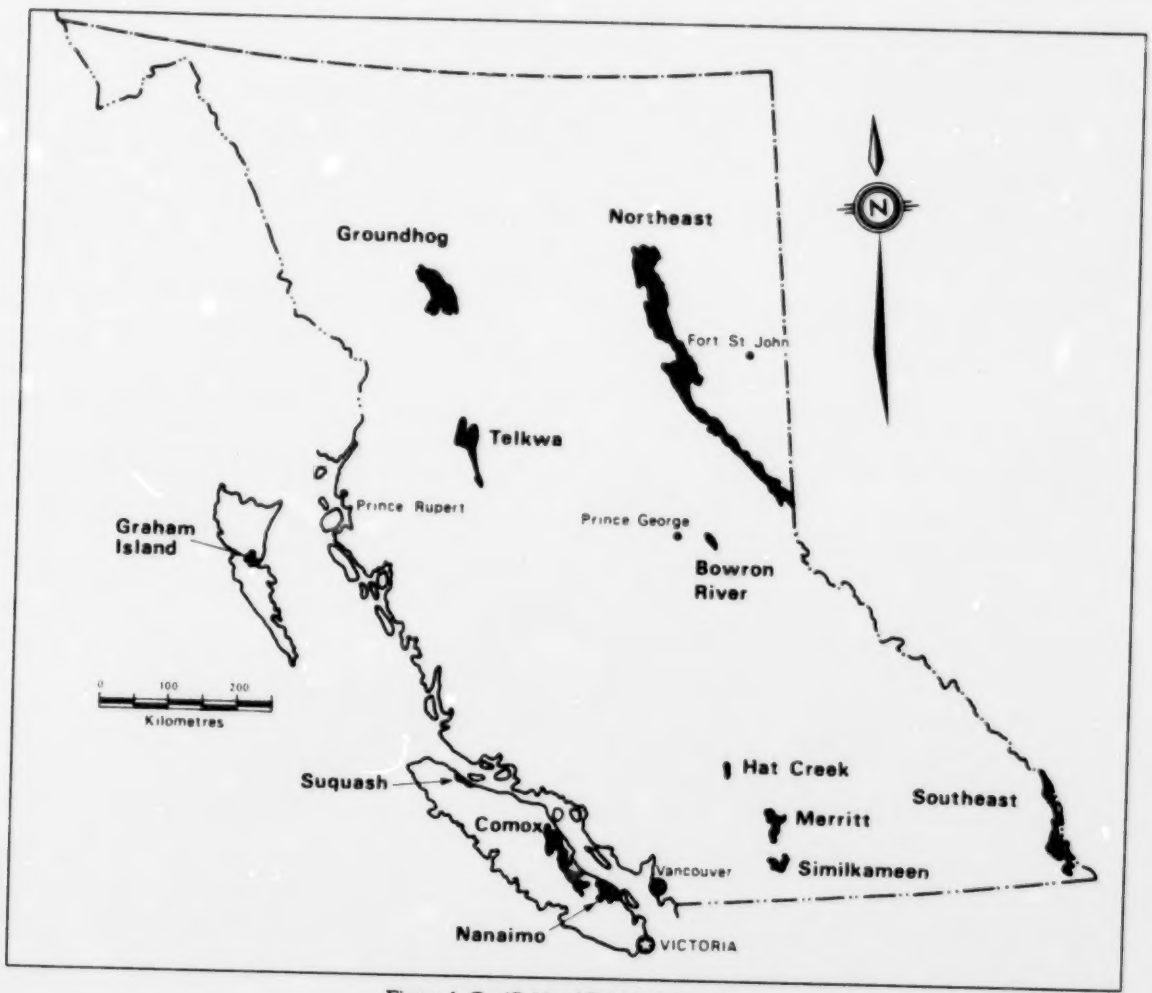

Figure 1. Coalfields of British Columbia.

reached the development stage, as a result, it is not dealt with in this paper. As anthracite, such as that of the Groundhog Basin, has very specialized uses and a different set of requirements, it has also been excluded. The province's bituminous and sub-bituminous coals, which are the subject of this report, may be of immediate interest to Ontario Hydro. The total *in situ* reserve and resource figure for thermal coal in British Columbia is 12.14 billion tonnes, almost 30 per cent of the entire provincial coal resource. At present, major coal production is from two areas in the province, the southeast and the northeast. Limited production is also obtained from Vancouver Island. With the exception of production from the Byron Creek and Quinsam properties, the coals are principally used for metallurgical purposes, however, about 15 per cent of the total is oxidized and as a result, is sold as thermal coal. The Telkwa coalfield in the west-central part of the province has a property in the pre-production stage which will produce thermal coals.

ACKNOWLEDGMENTS

The author would like to acknowledge the invaluable assistance of W. Kilby, D. Grieve, and J. Schwemler, particularly in the presentation of the analytical data (Appendix IV), and to B. Arnet for the time she has spent typing this report and D.J. Fehr for the typesetting and formatting which improved the presentation.

THE EAST KOOTENAY COALFIELDS

The East Kootenay coalfields, located in southeastern British Columbia, are comprised of three separate fields which extend from the Montana border northward and are known respectively as the Flathead, Crowsnest and Elk Valley Coalfields.

These are the most important coalfields of the province and have produced well over 100 million tonnes of metallurgical coal and about 10 million tonn of thermal coal from a number of different mines since 1898. All three fields are underlain by Jurassic-Cretaceous Kootenay Group strata, with the coal contained predominantly within the Mist Mountain Formation. There is a wide variation in the thickness of the Mist Mountain Formation with a resulting variation in the number of coal seams. Thus, where the formation is preserved in the Flathead coalfield, it contains only four or five seams, whereas in parts of the Elk Valley coalfield it contains in excess of 15 seams. Tectonism has caused repetition and structural thickening of seams, in many places enhancing reserves, while in some locations severe folding and faulting have hindered mining and effected quality.

In both the Elk Valley and Crowsnest coal basins, the coal measures are about 500 to 600 metres in thickness and contain up to 23 seams; the number of mineable seams ranges from 1 at Byron Creek to 10 and 11 at the Fording and Greenhills operations respectively, with an aggregate coal thickness of 55 metres. The coal resources

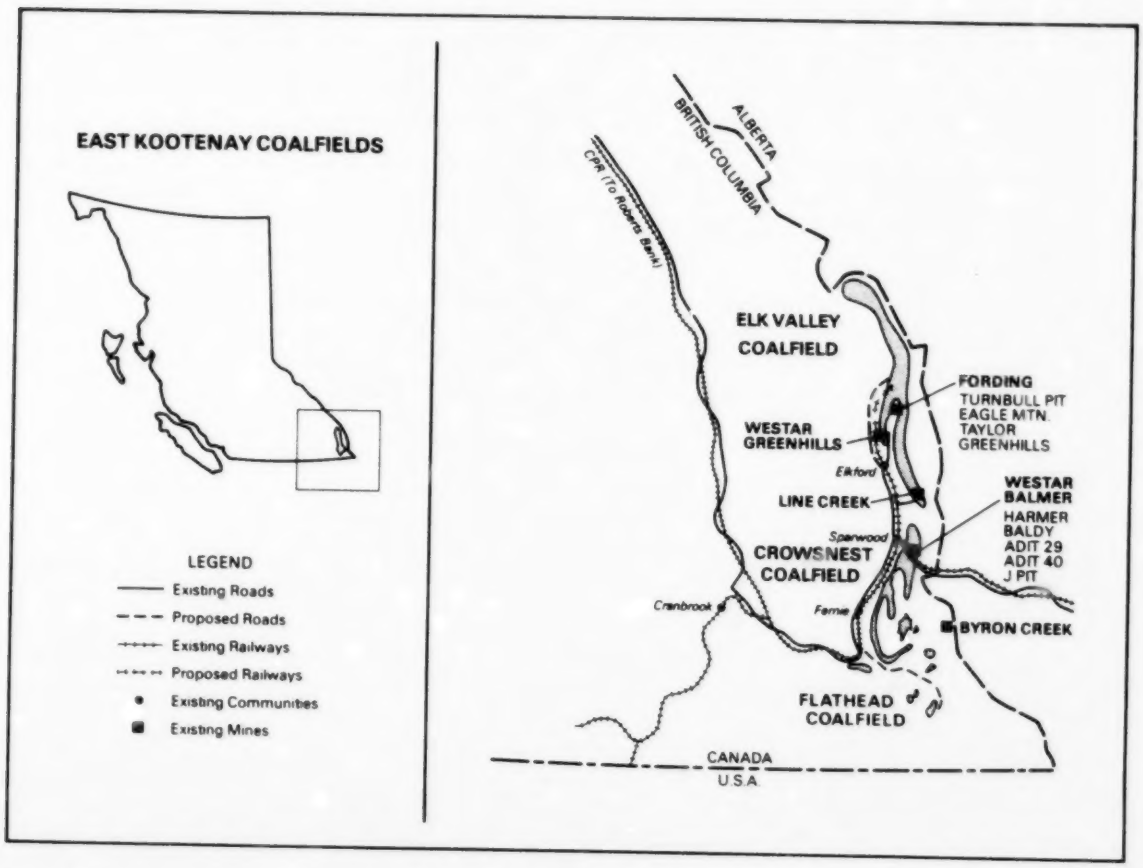

Figure 2. East Kootenay Coalfields.

of the Elk Valley, Crowsnest and Flathead coalfields are detailed in Table 1. Coal rank varies from low-volatile to high-volatile A-bituminous, with the five operating mines producing a range of coking, semi-coking and thermal coal products.

Appendix III gives the various multiplication factors required to convert chemical coal quality parameters from one basis to another. Naturally, these formulas cannot be applied to the ash properties, physical properties such as grindability and abrasion index and caking/coking properties of a coal. The factors are expressed in terms of the parameters most commonly available from coal quality data.

In the Crowsnest coalfield, Westar Mining Ltd., Balmer Operations, and Byron Creek Collieries Ltd. operate open pit mines which produce predominantly from one seam (the Mammoth seam at Byron Creek and the Balmer seam at Balmer), although Westar's dependence on the Balmer seam is decreasing with time. In the Elk Valley coalfield, Westar Mining's Greenhills Operations, Crows Nest Resources' Line Creek Mine, and the Fording River operations of Fording Coal Ltd. are open pit mines which produce from multiple seams. All five mines are truck-shovel operations, with the exception of Fording Coal which utilizes both truck-shovel and dragline mining systems.

TABLE 1
RESERVES OF COAL - EAST KOOTENAY COALFIELDS

	Geological *in situ* Coal (million tonnes)			
	Metallurgical Quality		Thermal Quality	
Property	Measured	Indicated	Measured	Indicated
Total geological *in situ* coal	1030	44	160	0
Total run-of-mine coal	880	22	120	0
Total saleable coal	540	14	110	0

INFRASTRUCTURE

Coal from southeastern British Columbia is shipped through two ports: the larger, Roberts Bank, has two berths, one of which is capable of handling 250 000 DWT (dead weight short tons) vessels. This facility handles all offshore coal shipments from the southeast except those from Byron Creek which pass through Port Moody, a port capable of taking 65 000 DWT vessels (Table 2).

PRODUCTION AND MARKETS

The sale of clean thermal coal has risen steadily this decade peaking in 1984 and 1986. It is estimated that sales in 1987 will be roughly equivalent to the previous year (Table 3).

International markets have expanded in recent years, and in addition to those countries listed in Table 4, include Finland, Holland and Egypt. Over 80 per cent of the thermal coal exported comes from southeastern British Columbia.

TABLE 3
PRODUCTION OF CLEAN THERMAL COAL
IN SOUTHEASTERN BRITISH COLUMBIA
Mine Production (tonnes)

Year	Westar	Byron Creek	Fording	Line Creek	Total
1981	403 675	441 237	-	-	844 912
1982	354 319	1 029 908	106 168	795 297	2 285 692
1983	444 906	1 292 148	60 255	611 058	2 408 367
1984	968 314	1 337 787	220 925	1 148 375	3 675 401
1985	743 170	1 048 297	178 376	998 827	2 968 670
1986	821 166	874 826	492 816	833 604	3 022 412
1987	2 198 816	614 672	837 617	567 815	4 218 920

TABLE 2
EAST KOOTENAY COALFIELDS
INFRASTRUCTURE TO TIDEWATER

Port	Throughput Capacity (million tonnes per year)			Operating Mines	Access via	Distance km
	Capacity	Total**	Thermal**			
Westshore Terminals Roberts Bank	24.0	12.7	2.9	Line Creek Crows Nest Resources	Rail-CP	1135
				Fording River Fording	Rail-CP	1170
				Greenhills Westar	Rail-CP	1150
				Balmer Westar	Rail-CP	1120
Pacific Coast Terminals Port Moody	1.5			Byron Creek Byron Creek Collieries	Rail-CP	1125
Thunder Bay	n/a*	0.9	0.9		Rail-CP	2200

*n/a - not announced
**1986

TABLE 4
NATIONAL AND INTERNATIONAL SALES OF BRITISH COLUMBIA THERMAL COAL (CLEAN) FROM 1981 TO 1985

Destination	Sales in Million Tonnes
Canada	
Ontario	3.84
British Columbia	0.67
Manitoba	0.43
Alberta	0.02
South Korea	5.34
Japan	4.86
Denmark	1.95
Hong Kong	1.22
United States	0.60
France	0.88
Spain	0.22
Taiwan	0.20
West Germany	0.03
Phillippines	0.17
Belgium and the Netherlands	0.17
Brazil	0.05
Total	20.65

PRODUCING MINES CROWSNEST COALFIELD:

BALMER (SPARWOOD) OPERATIONS

Operator: Westar Mining Ltd.
Owners: Westar Group, (66.6%)
Group of 10 Japanese coal consumers, (33.4%)

COAL SEAM DEVELOPMENT

The coal measures are about 610 metres thick, with between 45 and 52 metres of coal contained in 11 seams. Present production is mainly from the No. 10 (Balmer seam) which has an average thickness of 13.7 metres, but can be greater where local structural thickening occurs. The coal rank ranges from low to high-volatile bituminous with a tendency for the latter to occur in the upper seams (Appendix IV).

RESERVES

The total *in situ* coal reserves and resources of the property are approximately 300 million tonnes, of which about 10 per cent is thermal coal.

COAL PREPARATION AND PRODUCTION

The plant has two operation lines with a combined production capacity of 5.8 million tonnes per year.

The average annual coal production planned for the years from 1988 to 1991 is 9.05 million tonnes of raw coal yielding 5.7 million tonnes of clean coal at 62.5 per cent recovery. Due to current thermal coal prices, Westar is reducing its thermal coal sales.

MARKETS - PUBLISHED CONTRACTS

Location	Company	Contract From	Contract To	Annual Volume (000 tonnes)
California U.S.A.	Genstar Cement	04/86	n/a*	43.5
Washington U.S.A.	Columbia Cement (Bellingham)	1986	n/a	75
California U.S.A.	Cogeneration National (Stockton)	1985	2000	136
Ontario	Ontario Hydro	1987	n/a	180

*n/a = not available

SHIPPING SPECIFICATIONS - NOT AVAILABLE

BYRON CREEK, COAL MOUNTAIN

Operator: Byron Creek Collieries (1983) Ltd.
Owner: Esso Resources Canada Limited

COAL SEAM DEVELOPMENT

Mining is entirely in the Mammoth seam which is 30 to 60 metres thick, but may reach 200 metres apparent thickness as a result of local structural thickening. There is considerable variation in the ash content of the seam.

RESERVES

The *in situ* coal reserves are reported as 102 million tonnes and the indicated resources as 109 million tonnes.

COAL PREPARATION AND PRODUCTION

A new heavy-medium washing plant and drier complex with a capacity of 2 million tonnes per year began production in 1986; total plant capacity is now 3.6 million tonnes per year.

The proposed operating plan to 1990 will raise production to 2.3 million tonnes with a stripping ratio of 5.5 bank cubic metres per tonne clean coal. The coal is sold predominantly for thermal purposes though some is being sold as a soft coking coal.

MARKETS - PUBLISHED CONTRACTS

Country	Company	Contract From	Contract To	Annual Volume (000 tonnes)
Canada	Hudson Bay Mining & Smelting Company Ltd. Flin Flon, Manitoba	1987	1989	60
	Ontario Hydro	1977	1992	590
Japan	Sumitomo Metal Industries	1988	1989	N/A
	Nippon Kokan K.K.	1988	1989	N/A
	Kobe Steel	1988	1989	N/A

SHIPPING SPECIFICATIONS

	Thermal Coal	Low-Ash Coal
Total Moisture	8%	8%
Ash	15.1%	8.5% - 9%
Volatile matter	22.6%	21.0% - 22.5%
Fixed Carbon	54.3%	60.5% - 62.5%
Total Sulphur	0.3%	0.3%
Calorific Value	6370 kcal/kg	6830 kcal/kg
Hardgrove Index	75-80	75-80

PRODUCING MINES ELK VALLEY COALFIELD:

GREENHILLS OPERATIONS

Operator: Westar Mining
Owners: Westar Group (80%)
Pohang Iron and Steel (South Korea), (20%)

COAL SEAM DEVELOPMENT

Only a few of the 29 known coal seams on the property are economic. There are five major seams, continuous throughout the property, which constitute about 68 per cent of the *in situ* reserves.

Seams lower in the sequence (Nos. 1, 7 and 10) are medium-volatile bituminous coals, whereas the higher seams (16 and 20) are high-volatile A bituminous (Appendix IV).

RESERVES

The proven mineable reserves are reported as 104.1 million tonnes of which about 20 per cent is thermal coal.

COAL PREPARATION AND PRODUCTION

The anticipated annual production of clean coal through to the year 1990, at a stripping ratio of 4.0 bank cubic metres per tonne raw coal, is 2.1 million tonnes of coking coal and 0.8 million tonnes of thermal coal. Due to current thermal coal prices, Westar is reducing its thermal coal sales.

MARKETS - PUBLISHED CONTRACTS

Country	Company	Contract From	Contract To	Annual Volume (000 tonnes)
Denmark	Elkraft Power Co.	1982	1991	400 (to be shared) with Balmer
Hong Kong	Kowloon Electric Supply Co.	1982	1988	250-500
South Korea	Korea Electric Power Corp.	1982	1987	250

SHIPPING SPECIFICATIONS (RAW COAL)

Total Moisture	10%
Inherent Moisture	1.5%
Ash	16%
Volatile Matter	25.0% - 28.0%
Fixed Carbon	54.5% - 57.5%
Total Sulphur (adb)	0.5%
Calorific Value (adb)	6900 kcal/kg
Ash Fusion Temp. (initial)	1300°C
Hardgrove Index	70 - 80
Size	50 mm x 0

LINE CREEK

Operator: Crows Nest Resources Limited
Owner: Shell Canada Resources Limited

COAL SEAM DEVELOPMENT

There are seven coal seams with average thicknesses varying from 2.8 to 11.6 metres and with an aggregate thickness of up to 55 metres. Ninety per cent of the reserves are in the four lowest seams. Though seam No. 8 is the thickest, and is mainly metallurgical, it has good thermal coal properties. The coals vary in rank from low to medium-volatile bituminous (Appendix IV).

RESERVES

The *in situ* coal reserves and resources at an average stripping ratio of 5.24 bank cubic metres per tonne clean coals are: reserves 44.5 million tonnes, resources 180 million tonnes. About 20 per cent of the entire reserves and resources are thermal.

COAL PREPARATION AND PRODUCTION

The total annual production capacity is 2.7 million tonnes, of which a portion (by-product of the metallurgical coal) is thermal coal, the washing yield is about 68 per cent at 15-17 per cent ash. As the pits get progressively deeper, and the oxidized coal less, the production of thermal coal diminishes.

MARKETS

Most thermal coal sales are committed to Korea; surpluses may be sold elsewhere. Sales in thousands of tonnes are summarized in the following table:

Thermal Coal Destinations

	Korea (000 tonnes)	Other (000 tonnes)	Total (000 tonnes)
1984	827	243	1070
1985	1151	101	1252
1986	834	-	834
1987	735	-	735

PUBLISHED CONTRACTS

Location	Company	Contract From	Contract To	Annual Volume (000 tonnes)
South Korea	Kepco	1985	1989	n/a*
	Ssang Yong	1982	1991	35
Japan	Nihon Cement	1985	-	50

*n/a = not available

SHIPPING SPECIFICATIONS

	Clean Coal	Unwashed Coal
Total Moisture	8%	6%
Ash	17% Max	23%
Volatile Matter	21% Min	17 - 20%
Total Sulphur	0.5%	0.5%
Calorific Value	6400 kcal/kg	6400 kcal/kg
Size	50 mm x 0	50 mm x 0

FORDING RIVER OPERATIONS

Operator: Fording Coal Ltd.
Owner: Fording Coal Ltd. - a subsidiary of CP Ltd.

COAL SEAM DEVELOPMENT

The coal-bearing formation is 500 metres thick and contains at least 20 seams which are mineable (*ie.* individual seam thickness greater than 1.5 metres). The aggregate thickness of these seams is from 45 metres to 70 metres. The largest seam averages 10 metres in thickness. The coal is medium-volatile to high-volatile bituminous in rank (Appendix IV).

RESERVES

The majority of the reserves occur in the Eagle Mountain area, followed by the Greenhills, Elco, and Turnbull areas. The total *in situ* open pit reserves exceed 300 million tonnes of metallurgical coal and 30 million tonnes of thermal coal.

COAL PREPARATION AND PRODUCTION

The planned annual production is 5.6 million tonnes of metallurgical coal and 400 000 tonnes of thermal coal for the next 30 years (from 1988 to 2018). All production is by conventional open pit mining methods and will be at an overall stripping ratio of 7.0:1 (bank cubic metres of waste to metric tonnes of clean coal produced). Washplant yield varies from 50 to 80 per cent, depending on the seam being processed, averaging 67 per cent. Ash content of the cleaned product varies from 6 to 15 per cent, depending on the seam and product specifications.

MARKETS - PUBLISHED CONTRACTS

Location	Company	Contract From	Contract To	Annual Volume (000 tonnes)
South Korea	Korea Electric Power Corp.	1982	1991	250
Canada	Ontario Hydro	1988	-	180
Canada	Steel Brothers Cement	1982	1990	30
USA	Lehigh Portland Cement Washington State	1982	-	20

SHIPPING SPECIFICATIONS - PRODUCT RANGE

Ash	7.0% - 15.0%
Moisture	8.0% - 12.0%
Volatile Matter	20.0% - 31.0%
Fixed Carbon	55.0% - 66.0%
Sulphur	0.35% - 0.75%
Calorific Value (daf)	7800 kcal/kg - 8700 kcal/kg

THE PEACE RIVER COALFIELD

The Peace River coalfield, situated in the northeast part of the province, produced about 100 000 tonnes of medium-volatile bituminous coal with intermittent production from small mines between 1908 and 1960. The area was subjected to a high level of exploration activity from 1978 to 1984.

Coal measures are contained in the Cretaceous Gething and Gates Formations. In the southern part of the field the major portion of the coal resource is contained in the Gates Formation, whereas in the northern part the older Gething Formation contains most of the coal.

Well-developed coal in the Gates Formation is found southeast of the Sukunka River and extends along the foothills into Alberta; northwest of the Sukunka River the formation is dominantly marine. The mineable thickness of coal reaches 22 metres in four seams at the Quintette mine. Here the single most important seam is the J seam which reaches 10 metres in thickness and has great lateral extent. J seam is equivalent to the A (or B?) seam at the Bullmoose mine and seam B4 in the Monkman deposit.

Well-developed coal in the Gething Formation extends from the Pine River southeast to Kinuseo Creek. Thinner, but still economically interesting coal is present as far north as Williston Lake (Carbon Creek deposit). North of Williston Lake the Gething Formation is dominantly marine. Significant deposits in the Gething Formation include Burnt River (lower Gething coal) and Sukunka (upper Gething coal). Seam 60 at Burnt River reaches 8 metres in thickness and at Sukunka, the Bird and Chamberlain seams are up to 5 metres thick. Thick and continuous coal development in the Gates and Gething Formations is related to cycles of marine transgression and regression.

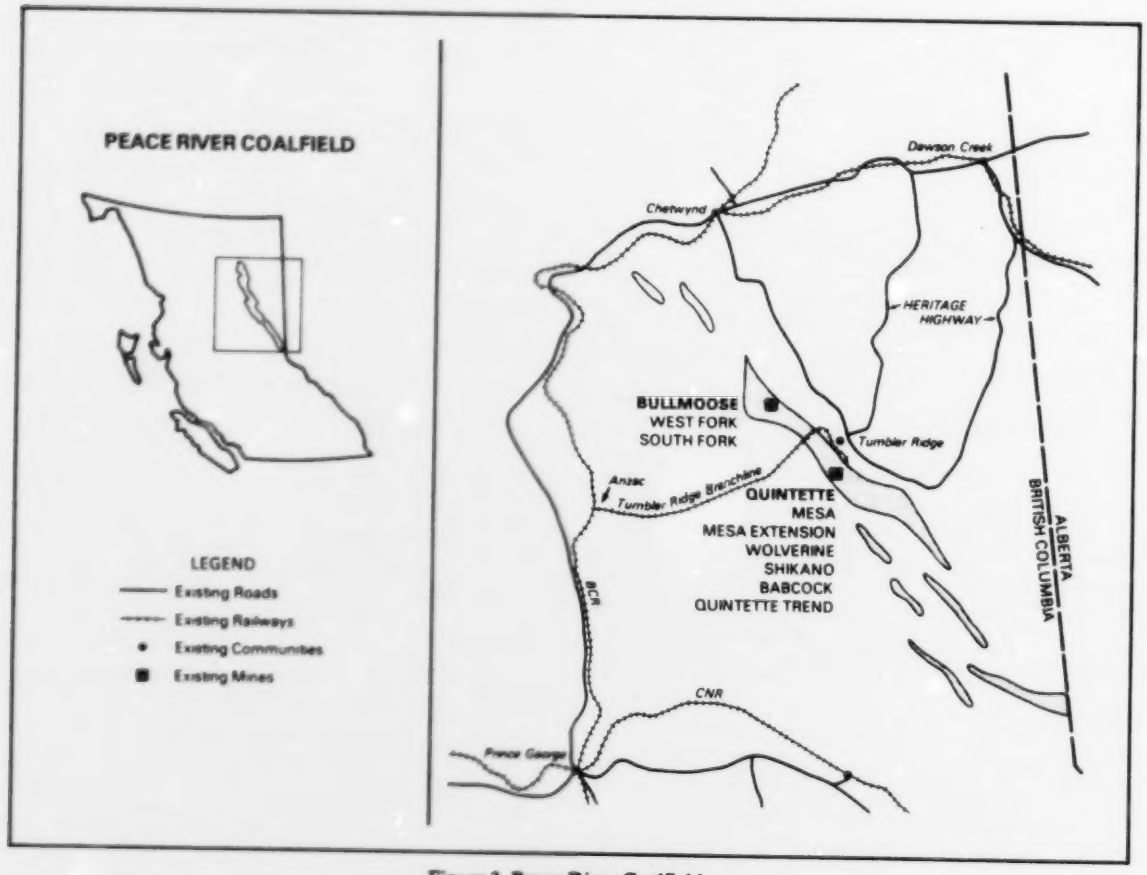

Figure 3. Peace River Coalfield.

TABLE 6
PEACE RIVER COALFIELD
INFRASTRUCTURE TO TIDEWATER

Port	Throughput Capacity (million tonnes per year)			Operating Mines	Access via	Distance km
	Capacity	Total**	Thermal**			
Ridley Island	10 - 12	7.12	0.12	Quintette	Rail (BCR/CNR)	995
				Bullmoose	Rail (BCR/CNR)	1065

**1986

In the foothills region up to five marine cycles are known in the Gates Formation and two (one major, one minor) are recognized in the Gething. The Gates and Gething coal measures have both been severely effected by Rocky Mountain tectonism so that structural separation and repetition are common. The rank of the coal varies from semi-anthracite to high-volatile bituminous, with Gates coal generally showing better coking quality.

The reserves and resources of the coalfield as assessed for the major properties, Carbon Creek, Burnt River, Sukunka, Mount Spieker, Monkman, Saxon, Quintette and Bullmoose are shown in Table 5 but only the two latter properties are in production.

TABLE 5
RESERVES OF COAL - PEACE RIVER COALFIELD

Property	Geological *in situ* Coal (million tonnes)			
	Metallurgical Quality		Thermal Quality	
	Measured	Indicated	Measured	Indicated
Carbon Creek				
Burnt River				
Sukunka				
Bullmoose	470*	290*	110*	7.8*
Mount Spieker				
Quintette				
Monkman				
Saxon				

*Figures are totals for all properties listed.

INFRASTRUCTURE

The coal port on Ridley Island at Prince Rupert was completed at the end of 1983, primarily to provide port facilities for northeast coal shipments (Table 6). The coal is carried by the British Columbia Railway from the mines to Prince George where the coal trains are switched to the Canadian National Railway northern main line, and then continue to Prince Rupert. Ridley Island has one berth which is capable of handling 250 000 DWT vessels.

PRODUCTION AND MARKETS

Production of coal for export started in the Peace River region in 1983 with Quintette producing both metallurgical and thermal coal and Bullmoose producing metallurgical coal exclusively. The following year both mines were producing both commodities and the production of thermal coal peaked (Table 7).

Less than 20 per cent of thermal coal exported from the province comes from the Peace River coalfields. The total provincial figures are shown in Table 4.

TABLE 7
PRODUCTION OF CLEAN THERMAL COAL
NORTHEASTERN BRITISH COLUMBIA

Year	Mine Production (tonnes)		
	Quintette	Bullmoose	Total
1983	39 650	-	39 650
1984	703 331	66 780	770 111
1985	713 244	69 618	682 862
1986	105 055	10 000	115 055
1987	9 037	-	9 037

PRODUCING MINES PEACE RIVER COALFIELD:

QUINTETTE

Operator: Quintette Coal Ltd.
Owners: Denison Mines Limited (50%)
Mitsui Mining Overseas Development (12.5%)
Carbonnages de France (12.0%)
Tokyo Boeki Ltd. (10.5%)
Sumitomo Corporation (5.0%)
Nine Japanese firms (for example, Nippon Steel)(10%)

COAL SEAM DEVELOPMENT

The Gething and Gates formations both contain coal seams on the property, but all the reserves are in the Gates Formation. The coal is medium-volatile bituminous.

RESERVES

Pit	No. and Name of Seams	Thickness (m)	Total (m)
Mesa	4: D, F, G & J	1.88-9.32	22.5
Wolvervine	9: D, E_1, E_2, F_2, G_1 G_2, J_1-J_3	0.84-3.12	16.7
Shikano	5: E, E_3, G, J & K	1.41-5.17	19.0
Babcock	6: D, E, F, G, J & K	1.94-5.69	18.5

Mineable thermal coal reserves by pit areas are as follows:

Pit	Raw Coal (000 tonnes)
Mesa	1545
Mesa Extension	444
Wolverine	4168
Shikano	3905
Babcock	5106
Quintette Trend	2988
Roman	2322
TOTAL	20478

COAL PREPARATION, PRODUCTION, MARKETS AND SHIPPING SPECIFICATIONS

Quintette has not shipped thermal coal since 1986.

BULLMOOSE MINE

Operator: Teck Corporation
Owners: Teck Corporation (51%)
Lornex Mining Corporation Ltd. (39%)
Nissho Iwai Coal Development (Canada) Ltd. (10%)

COAL SEAM DEVELOPMENT

The coal occurs in the Gates Formation where 80 metres of coal measures contain five seams with an aggregate thickness of 12.6 metres.

The individual seams vary in thickness from 1.4 metres to 4.8 metres. The coal is medium-volatile bituminous.

Seam	South Fork Pit
A	2.6 m
B	4.8 m
C	1.8 m
D	2.0 m
E	1.4 m

RESERVES

Mineable reserves, at an average projected stripping ratio of 4.5 bank cubic metres per tonne of raw coal are broken down by seam as follows:

Seam	Tonnage (000)	Percentage of Total
A	19 000	24.2
B	35 300	43.1
C	12 600	15.4
D	12 300	15.0
E	1 900	2.3
TOTAL	81 100	100.0

A little over 4 per cent of total mineable reserves is thermal coal.

COAL PREPARATION AND PRODUCTION

An annual production of 3 million tonnes of raw coal will yield 2.3 million tonnes of clean coal, this includes about 0.06 million tonnes of thermal coal.

MARKETS - PUBLISHED CONTRACTS

Not available

SHIPPING SPECIFICATIONS

	Raw Coal
Total Moisture	8.0%
Inherent Moisture	2.5%
Ash	15%
Fixed Carbon	55%
Volatile Matter	22%
Total Sulphur	0.5%
Calorific Value	7000 kcal/kg
Ash Fusion Temperature	1250°C - 1470°C
Hardgrove Index	81-82
Size	5 mm x 0

THE TELKWA COALFIELD

This coalfield has produced intermittently since 1918, but of the 433 000 tonnes produced to 1970, most was for domestic consumption. Intensive exploration has been conducted in recent years and substantial resources of good quality thermal coal have been delineated.

The Telkwa and Red Rose coal measures locally exceed 400 metres in thickness. They correlate with the lower part of the Cretaceous Skeena Group. The coal measures are folded and faulted; however, areas of shallow dips provide favourable sites for potential open pit mining. In places as many as ten coal seams occur, with individual seams up to 7.5 metres thick. The coals vary in rank from medium to high-volatile bituminous.

INFRASTRUCTURE

Ridley Island at Prince Rupert is reachable by either rail (CNR) or road, with a 400 kilometre haul. In the former case, a short (5 km) spur line would be required to connect the mine with the CNR main line at Telkwa.

PROSPECTIVE MINE TELKWA COALFIELD:

TELKWA

Operator: Crows Nest Resources Limited
Owner: Shell Canada Limited

COAL SEAM DEVELOPMENT

The coal measures in the upper sequence vary in thickness from 85 to 100 metres in the centre of the field, and consist of ten major seams varying from 0.5 to 7.5 metres thick, with an aggregate thickness of 14 to 18 metres.

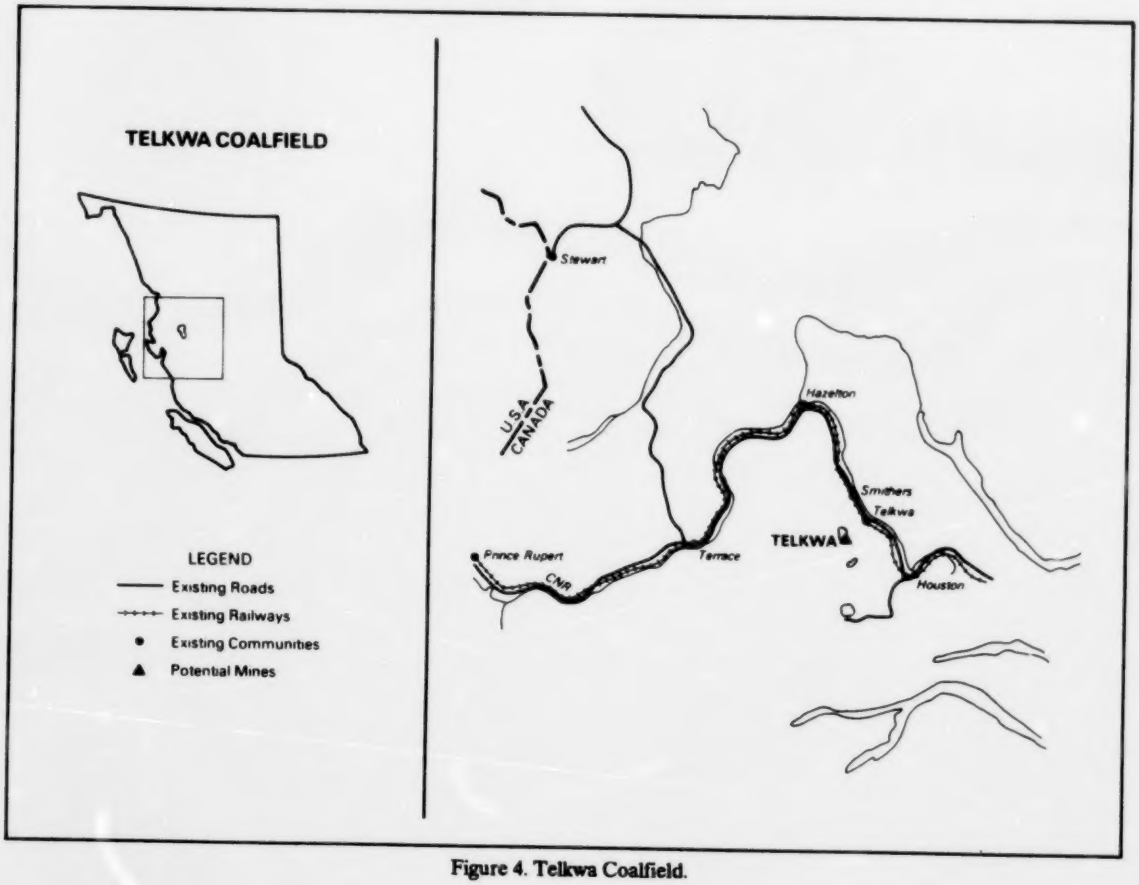

Figure 4. Telkwa Coalfield.

The lowermost seam, No. 1 in the lower sequence, is about 100 metres below No. 2 seam, and separated from it by a marine unit. However, only a very small tonnage may be extracted from No. 1 seam, and as a result it has been discounted in the reserve calculation. The product is a medium to high-volatile bituminous thermal coal.

RESERVES

Using a cut-off of 0.6 metres for seams numbered 2 to 10, the *in situ* coal resource is estimated to be 50 million tonnes of surface mineable coal distributed as follows:

Area	Resource (million tonnes)
North	10
East	30
Possible extensions	5
West	5
TOTAL	50

MINING

Coal recovery is planned from up to eight open pits by conventional truck and shovel methods. Mineable reserves are in the order of 22 million tonnes of raw coal.

COAL PREPARATION AND PRODUCTION

The preparation plant will have a design capacity for an annual production of 800 000 tonnes of clean thermal coal.

PROJECTED SHIPPING SPECIFICATIONS

On an as-received basis:

Total Moisture	10%
Ash	11%
Total Sulphur	1.0%
Volatile Matter	24.5% - 26.5%
Calorific Value	6480-6550 kcal/kg
Hardgrove Index	60
Ash Fusion Temp. (initial)	1300°C

GOVERNMENT APPROVALS

Approval-in-principal for mine development was received from the Government of British Columbia in November 1986.

VANCOUVER ISLAND COALFIELDS

The economic coal deposits of Vancouver Island occur in the late Cretaceous Nanaimo Group. Significant deposits are restricted to two major basins, the Nanaimo coalfield and, immediately to the north, the Comox coalfield. The coal is essentially a thermal coal, though some may be used as a soft coking coal.

Over the 100-year period which ended in 1953, more than 50 million tonnes were produced from the Nanaimo coalfield. Coal was extracted from three seams, the Douglas, Newcastle and Wellington. The area was considered to be largely mined out. However, a recent evaluation of the Nanaimo coalfield estimates an *in situ* resource of 8 million tonnes of coal. The dormant Wolf Mountain mine is located in this coalfield 10 kilometres southwest of Nanaimo.

In the Comox coalfield 18.6 million tonnes of coal was extracted from three principal seams between 1888 and 1953. The coal was mined underground from these seams and the product was high-volatile bituminous in rank. Quinsam lies 30 kilometres southwest of Campbell River near the northern extremity of the Comox coalfield.

INFRASTRUCTURE

The deposits are favourably located near tidewater on the east coast of Vancouver Island. The proposed route for the export of Quinsam coal is 32 kilometres by road from the mine to the barge loading site, 50 kilometres from Middle Bay on Texada Island where suitable port facilities exist for local distribution; it could also be barged from there to Westshore Terminals for export.

The Mid-Island coal project proposed to incorporate coal from the Wolf Mountain mine and fines reclaimed from waste dumps, all of which are located in the

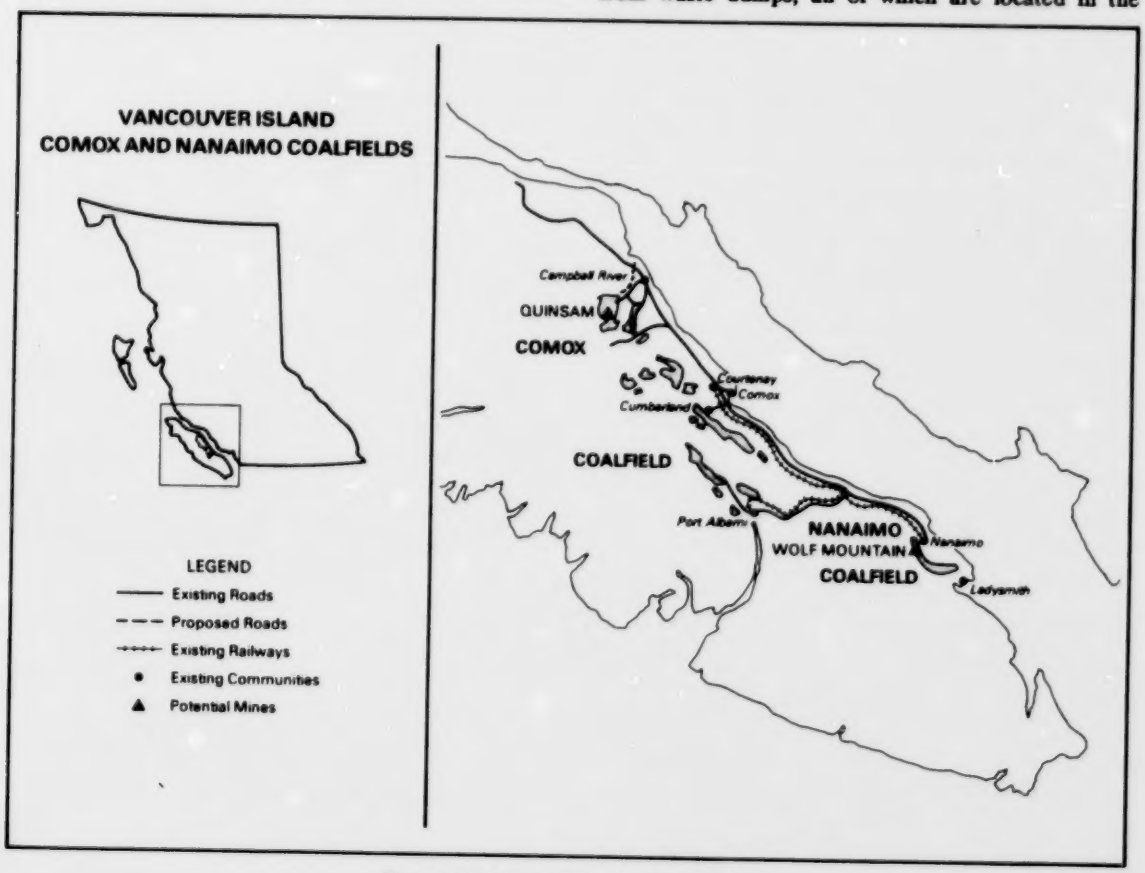

Figure 5. Comox and Nanaimo Coalfields.

Nanaimo coalfield. Raw coal from Wolf Mountain was to be transported by road to the preparation plants located within 6 kilometres of the port facilities where it was to have been processed with the material from the various waste dumps.

PRODUCING MINE COMOX COALFIELD:

QUINSAM

Operator: Quinsam Coal Ltd.
Owners: Brinco Coal Corp.

COAL SEAM DEVELOPMENT

There are three coal zones on the Quinsam property with thicknesses varying from 0.3 to 4.0 metres. In the Comox Formation the aggregate thickness of the seams varies from 4 to 8 metres in coal measures which in places reach 90 metres in thickness. In general the rank of the coal is high-volatile B bituminous.

RESERVES

The *in situ* reserves are estimated at 43.5 million tonnes of which 23.6 million tonnes are recoverable by surface mining and 19.9 million tonnes by underground methods. The mining yield is estimated at 91 per cent at an average stripping ratio of 8.6 bank cubic metres per tonne raw coal in the open pit.

COAL PREPARATION AND PRODUCTION

Production started in 1986 with 7000 tonnes, followed by 14 500 tonnes in 1987. One hundred and fifty-five thousand tonnes is scheduled for 1988 with an increase in subsequent years to an annual production of 1 million tonnes. The present product is raw run of mine coal crushed and screened.

Markets for the coal are being sought in the Pacific Rim countries, British Columbia, and the U.S.A. There is also the possibility that it may be economically viable to ship the coal to eastern Canada and Europe on Panamax vessels via the Panama Canal.

SHIPPING SPECIFICATION - ON A RUN-OF-MINE BASIS

Total Moisture	8.0% maximum
Residual Moisture	3.5% average
Ash Content	13.5% maximum
Fixed Carbon	48.0% ± 1.0%
Volatile matter	36.5% ± 1.0%
Total Sulphur	1.0% maximum
Calorific Value	6200 kcal/kg
Hardgrove Index	45 minimum
Ash Fusion Temp. (initial)	1250°C

PROSPECTIVE MINE NANAIMO COALFIELD:

MID-ISLAND COAL PROJECT

Operator: Mid-Island Coal Company
Owner: Bel Construction Ltd.

COAL SEAM DEVELOPMENT

Only one of the six seams found on the Wolf Mountain property is of economic interest. The seam averages 2.5 metres in thickness and is correlated with the Wellington seam of the Extention-Protection Formation.

RESERVES

No reserves have been published.

COAL PREPARATION AND PRODUCTION

The plant would be capable of handling a minimum of 250 000 tonnes and a maximum of 500 000 tonnes of raw coal annually. The supplies would have been drawn from various tailing dumps in the area and the Wolf Mountain underground mine.

MARKETS

Markets are being sought in the Pacific Rim countries, British Columbia and the U.S.A.

PROJECTED SHIPPING SPECIFICATIONS

On an air-dried basis:

Moisture	2.5%
Ash	12.3%
Volatiles	35.2%
Fixed Carbon	50.0%
Sulphur	0.39% - 0.62%
Calorific Value	12 000 Btu
Ash Fusion Temp (initial)	1252°C
Hardgrove Index	55-68
Free Swelling Index	2.5-4.0

COAL QUALITY

The Federal/Provincial Task Force report "Western Canadian Low Sulphur Coal: Its Expanded use in Ontario, Technical Report 1986," dealt with coal quality (Table 8). No quality data, however, are given on any of the British Columbia coals.

In the report, Western Canadian Bituminous coals were considered to be a combination of coals from current Alberta and B.C. suppliers. Coal from the latter has a significantly higher heating value than the Alberta suppliers. A variety of B.C. producers can surpass the Western Canadian Bituminous quality specification and several approach the Eastern U.S. Bituminous coal quality with low-sulphur contents.

This study indicates that the Quinsam property on Vancouver Island could provide a supply of good quality coal at a more competitive price than coal from Alberta and the interior of British Columbia. It is also interesting to note that of all the thermal coal in the province, the Vancouver Island coal is the closest in quality to the eastern bituminous coal imported by Ontario Hydro from the United States. A comparison is set out in Tables 8 and 9 below. Washing would not only reduce the ash content but enhance the calorific value and reduce the sulphur content making it an eminently suitable contender for that market.

TABLE 9
COAL QUALITY COMPARISON

	Eastern Bituminous %	High Volatile Bituminous	
		Comox %	Nanaimo %
Moisture	4-8	0.98-4.29	2.0-2.5
Ash	8-10	10.37-14.58	10.32-14.89
Volatiles	35-36	27.51-37.21	36.93-39.09
Fixed Carbon	50-59	47.23-58.03	45.34-48.56
Sulphur	2.21	0.39-1.35	0.42-0.96
BTU	13 000-13 300	9 916-13 000	12 090-12 884

Appendix IV sets out the thermal coal quality, as received basis, of 100 samples from the Northeast, the Southeast, Telkwa and Vancouver Island coalfields. The analyses include Proximate, Ultimate, Sulphur, Ash Constituents, FSI, Hardgrove Index, Ash Fusion Temperature, and Calorific Value. The mine, pit and seams from which the samples were taken are identified. The data may be manipulated as desired and, as an example, Table 10 sets out the proximate analysis of coals with less than 15 per cent ash and the percentage of samples falling into that category in each coalfield.

TABLE 8
WESTERN CANADIAN LOW-SULPHUR COALS

	ALBERTA High Volatile Bituminous	Sub-Bituminous	SASKATCHEWAN Beneficiated Lignite	UNITED STATES Eastern Bituminous
Moisture	6-9	17-25	12-14	5.5-6.5
Ash	15-30	7-20	9-15	7-9
Volatiles	35-40	30-38	26.10	33-37
Fixed Carbon	-	-	46.8	50.72
Sulphur	0.3-0.4	0.3-0.4	0.2-0.4	1.5-2.5
BTU	7 500-10 000	8 000-9 000	9 500	13 000-13 300

TABLE 10
PROXIMATE ANALYSIS OF COALS <15% ASH

Coalfield	Crowsnest	Elk Valley	Peace River	Telkwa	Comox	Nanaimo
Percentages of samples	52	22	30	22	50	100
Moisture %	1.02-5.52	1.38-16.53	0.52-1.17	1.3-4.02	0.98-4.29	2.0-2.5
Ash Content %	10.7-14.9	5.26-13.72	5.47-14.77	4.4-14.6	10.37-14.58	10.32-14.89
Volatile Mat %	18.27-24.9	22.63-27.67	18.76-24.48	23.9-25.06	27.51-37.21	36.93-39.09
Fixed Carbon %	56.7-66.39	47.3[illegible]-62.27	62.0-70.11	60.2-66.56	47.23-58.03	45.34-48.56
Sulphur %	0.14-0.3	0.43-0.7	0.26-1.16	0.2-0.33	0.39-1.35	0.42-0.96
BTU	11 985-13 054	9 399-11 985	13 341-14 397	12 776-13 711	9 916-13 000	12 090-12 884

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GLOSSARY

C.V.:	Calorific value.
AIR DRIED:	The moisture in the coal is in equilibrium with the moisture in the atmosphere.
dmmf:	(Dry mineral matter free) The hypothetical condition in which coal or coke is calculated to be free of both moisture and mineral matter.
HARDGROVE INDEX:	The grindability test used to determine the ease of pulverization in comparison with certain coals chosen as standards. The range varies from 20 to over 110: the higher the number, the more easily the coal is ground.
ASH FUSION TEMPERATURES:	The temperature at which the softening and melting characteristics are measured according to standard procedures, in both midly oxidizing (higher) and midly reducing (lower) conditions. Temperatures measured are at initial deformation, softening, hemispherical and fluid.
SULPHUR:	*pyritic*: High concentrations are usually associated with a marine depositional environment. *organic*: Is chemically bonded in the coal substance and is usually associated with sulphate. *sulphates*: Mainly calcium and iron. Very minor quantities (a few hundredths per cent) except in highly weathered or oxidized samples.

APPENDICES

APPENDIX I
SUMMARY OF COAL QUALITY REQUIREMENTS CEMENT MANUFACTURE

Parameter	Desired	Typical Limits*	Comments
Total Moisture (%) (as received)	4-8	max 12 (max 15)	Reduces net C.V. Limited to approximately 15% max for easy handling/grinding. Limits should be higher for low rank coals.
Ash (%) (air dry)	up to 15	max 20 (max 40-50)	Ash content of little influence except it must be constant within ±2% and composition consistent in order to compensate by adjusting feed ratios.
Volatile Matter (%) (dmmf)	various	(max 24)	Dependent on firing system but usually flexible. (In cases of old bin-and-feeder systems for safety and insurance purposes.)
Gross Calorific Value (air dried) kcal/kg	various	min 5020	Consumers have varying preferences for basis of calculation gross/net air dried/as received).
Total Sulphur (%) (air dried)	up to 2	max 2-5	Dependent on sulphur content of feed materials. Sulphur content of clinker to be less than 1.3%.
Chlorine (%) (air dried)	low	max 0.1	In dry process, chlorine content of clinker to be less than 0.03%. Depending on chlorine content of feed material, max content in coal varies up to 0.1%.
P_2O_5 (%) (ash analysis)	up to 2	max 6-8	P_2O_5 content of clinker to be less than 1%. Though dependent on P_2O_5 content of feed material, seldom a critical factor.
Hardgrove Index (air dry)	high	min 50-55 (min 40)	Dependent on available grinding capacity and required throughput.
Max Size (mm)	25-30	35-40	Limited by top size accepted by pulverizer.
Fines Content (%) (less than 0.5 mm)	15-20	25-30	Limited for good handling characteristics, specifically when wet.

**Typical limits refer to those commonly quoted by consumers; those in brackets indicate outer limits acceptable in some cases.*

APPENDIX II
SUMMARY OF COAL QUALITY REQUIREMENTS POWER GENERATION

Parameter	Desired	Typical Limits*	Comments
Total Moisture (%) (as received)	4-8	max 12 (max 15)	Reduces net C.V. Limited to approximately 15% for easy handling/ grinding. Limits will be higher for low rank coals.
Ash (%) (air dried)	low	max 15-20 (max 30)	Reduces C.V. Limited by ability of consumers equipment to handle and dispose of ash.
Volatile Matter (%) (dmmf)	25-35 15-25	min 25 max 25	Side-fired p.f. furnace. Pulverized fuel. Down-fired p.f. furnace. Pulverized fuel.
Gross Calorific Value (air dried) kcal/kg	high	min 5736 5975	Consumers have varying preferences for basis of calculation (gross/ net, air dried/as received).
Total Sulphur (%) (air dried)	low	max 0.5-1.0 (max 2.0)	Usually dependent on local pollution regulations e.g. United Kingdom, 2.0% max; France (EDF), 1.7% max; Germany 1.0% max; Japan, 0.5% max. Small lots need not necessarily comply with limits.
Ash Fusion Temp. C (oxidizing or reducing)	high deformation	min 1200 (min 1050)	Dry bottom furnaces. Minimum acceptable deformation temp. dependent on flexibility of consumers equipment and operating procedures.
	low fluid	max 1350 (max 1430)	Wet bottom furnaces. Maximum fluid temp. dependent on operating temperatures. Furnace conditions to dictate whether oxidizing or reducing ash fusion temperatures are applicable.
Nitrogen (%) (dmmf)	low (0,8-1.1)		Preferably low to reduce NO_x formation. (Range preferred by Dengen Kaihatsu, Japan).
Chlorine (%) (air dried)	low	max 0.1-0.3 (max 0.5)	As indication of alkali content, should be low to reduce tendency for ash fouling.
Hardgrove Index (air dry) Max Size (mm)	high 25-30	min 50-55 (min 45) 35-40	Dependent on available grinding capacity and required throughput. Limited by top size accepted by pulverizer.
Fines Content (%) (less than 0.5 mm)	15-20	25-30	Limited for good handling characteristics, specifically when wet.

**Typical limits refer to those commonly quoted by consumers; those in brackets indicate outer limits acceptable in some cases.*

APPENDIX III
FORMULAS FOR THE CALCULATION OF RESULTS TO DIFFERENT BASES

Given \ Required	As received (ar)	Air dried (ad)	Dry (dry)	Dry ash free (daf) (dmmf)	Dry, mineral matter free
As received (ar)	—	$\frac{100-M_1}{100-M}$	$\frac{100}{100-M}$	$\frac{100(100-M_1)}{(100-M)(100-M_1-A)}$	$\frac{100(100-M_1)}{(100M)(100M-B)}$
Air dried (ad)	$\frac{100-M}{100-M_1}$	—	$\frac{100}{100-M_1}$	$\frac{100}{100-M_1-A}$	$\frac{100}{100-M_1-B}$
Dry (dry)	$\frac{100-M}{100}$	$\frac{100-M_1}{100}$	—	$\frac{100-M_1}{100-M_1-A}$	$\frac{100-M_1}{100-M_1-B}$
Dry, ash free (daf)	$\frac{(100-M)(100-M_1-A)}{100(100-M_1)}$	$\frac{100-M_1-A}{100}$	$\frac{100-M_1-A}{100-M_1}$	—	$\frac{100-M_1-A}{100-M_1-B}$
Dry, mineral matter free (dmmf)	$\frac{(100-M)(100M_1-B)}{100(100-M_1)}$	$\frac{100-M_1-B}{100}$	$\frac{100-M_1-B}{100-M_1}$	$\frac{100-M_1-B}{100-M_1-A}$	—

M total moisture content (as received)
M_1 inherent moisture content (air dried)
A ash content (air dried)
B mineral matter content (air dried)

The multiplication factors are given to convert chemical coal quality parameters from one basis to another. These formulas cannot be applied to the ash properties, physical properties and caking/coking properties of a coal. The factors are expressed in terms of the parameters most commonly available from coal quality data.

APPENDIX IV
ANALYSIS OF RAW COAL WITH FUEL POTENTIAL

COAL FIELD	OPERATOR	AREA	SEAM No.	SAMPLE SITE	STATUS	SEAM THICKNESS (metres)	ASTM RANK	DATA SOURCE	Proximate Analysis %				Ultimate Analysis % (As Received Basis)							Calorific Value			
									MOIST	ASH	VOLATILE MATTER	FIXED CARBON	C	H	Sulphur Forms PY	Sulphur Forms SULPHATE	Sulphur Forms ORG	T.S.	N	O	MJ/kg	BTU/lb	HCI	FSI
PC.RIV.	QUINT.COAL	QUINT.	E	FRAME/84sC	P[1]	-	MVBIT	MEMPR 81 (#61)	0.92	23.41	30.21	55.46						0.25					73	3
PC.RIV.	QUINT.COAL	QUINT.	E	FRAME/84sC	P	-	MVBIT	MEMPR 81 (#61)	0.88	27.47	19.87	51.78						0.42					80	2.5
PC.RIV.	QUINT.COAL	QUINT.	E	FRAME/84sC	P	-	MVBIT	MEMPR 81 (#61)	0.85	22.82	20.54	55.79						0.27					77	
PC.RIV.	QUINT.COAL	QUINT.	G	GRIZ/TRANS	D[2]	3.7	-	MEMPR 86 (#724)	0.57	39.70	14.39	45.0						0.32						
PC.RIV.	QUINT.COAL	QUINT.	J & K1	GRIZ/TRANS	D	7.13	-	MEMPR 86 (#724)	0.62	25.77	16.65	57.0						0.27						
PC.RIV.	QUINT.COAL	QUINT.	K	GRIZ/TRANS	D	1.12	-	MEMPR 86 (#724)	0.45	17.37	17.71	65.0						0.25						
PC.RIV.	QUINT.COAL	QUINT.	GT-1	GRIZ/TRANS	D	6.3	-	MEMPR 86 (#724)	0.47	22.35	15.97	61.0						0.47						
PC.RIV.	QUINT.COAL	QUINT.	F	FRAME/84sC	P	-	MVBIT	MEMPR 81 (#61)	0.73	29.34	19.67	50.24												
PC.RIV.	QUINT.COAL	QUINT.	G	FRAME/84sC	P	-	MVBIT	MEMPR 81 (#61)	0.88	30.00	19.27	49.85						0.49					74	1.5
PC.RIV.	QUINT.COAL	QUINT.	G	BIELAND	D	-	SUBBITC	MEMPR 85 (#697)	0.68	48.15	14.83	44.0						0.46					59	4
PC.RIV.	QUINT.COAL	QUINT.	A	FRAME/84sC	P	-	MVBIT	MEMPR 81 (#61)	0.82	16.45	22.97	65.76						0.55					89	3.5
PC.RIV.	QUINT.COAL	QUINT.	D	FRAME/84sC	P	-	MVBIT	MEMPR 81 (#61)	0.84	8.22	24.48	66.46						1.11			8910		69	2.9
PC.RIV.	QUINT.COAL	QUINT.	D	FRAME/84sC	P	-	MVBIT	MEMPR 81 (#61)	1.38	11.62	25.17	61.82						0.86					88	4
PC.RIV.	QUINT.COAL	QUINT.	D	FRAME/84sC	P	-	MVBIT	MEMPR 81 (#61)	0.77	16.06	21.97	59.22						0.42					178	2.5
PC.RIV.	TECK CORP	BULLMS.	A-1	MINE SURF.	P	-	MVBIT	MEMPR 81 (#61)	0.77	30.97	22.92	55.34						0.69					78	1
PC.RIV.	TECK CORP	BULLMS.	D	S. PORK	P	-	MVBIT	CANMET 85	1.17	5.47	25.26	70.11						0.79					68	2
PC.RIV.	TECK CORP	BULLMS.	E	MINE SURF	P	-	MVBIT	MEMPR 77 (#478)	1.1	43.0	18.4	38.7	52.93	4.39	0.02		0.28	0.30	1.24	4.62	33.49	14397	67	3
PC.RIV.	TECK CORP	BULLMS.	A1 & A2 COMP	S. PORK	P	-	MVBIT	CANMET 85	4.02	4.30	25.05	66.36	79.79	4.81	0.05		0.17	0.65	1.08			12365	72	2.5
PC.RIV.	TECK CORP	BULLMS.	A1 & A2 & A SPLT	S. PORK	P	-	MVBIT	MEMPR 77 (#478)	1.7	38.8	18.5	51.0	82.34	4.53				0.28	1.36	6.01	31.89	13711	68	3
TLKW	CRNT.RES.	TLKW	3	GOAT MEN E.	D	-	MVBIT	MEMPR 77 (#478)	1.2	30.6	16.4	43.8	81.49	4.52				0.31	1.07			13296	62	1
TLKW	CRNT.RES.	TLKW	4	GOAT MEN E.	D	2.18	HVBITB	MEMPR 83 (#238)	0.90	20.51	24.18	54.41	78.60	4.58				0.51	0.99			9160	91	1
TLKW	CRNT.RES.	TLKW	2	GOAT MEN E.	D	1.25	HVBITB	MEMPR 83 (#238)	0.91	19.58	26.85	52.75	79.43	4.89				1.07	0.71				75	3
TLKW	CRNT.RES.	TLKW	6	GOAT MEN E.	D	2.39	HVBITB	MEMPR 83 (#238)	0.87	27.19	24.86	47.09	74.58	4.69				1.02	0.93	11.7				
TLKW	CRNT.RES.	TLKW	7	GOAT MEN E.	D	2.51	HVBITB	MEMPR 83 (#238)	0.92	22.10	25.31	51.67	73.00	4.56				0.58	0.74	11.04				
TLKW	CRNT.RES.	TLKW	8	GOAT MEN E.	D	1.45	HVBITB	MEMPR 83 (#238)	1.00	20.19	26.48	52.32	72.84	4.53				0.75	1.11	12.47				
TLKW	CRNT.RES.	TLKW	9	GOAT MEN E.	D	2.18	HVBITB	MEMPR 83 (#238)	1.04	13.62	27.51	58.83	72.37	4.48				1.36	0.72	12.50				
TLKW	CRNT.RES.	TLKW	10	GOAT MEN E.	D	1.52	HVBITB	MEMPR 83 (#238)	0.98	12.68	31.11	55.23	70.84	4.45				1.35	0.72	11.47				
TLKW	CRNT.RES.	TLKW	5	GOAT MEN E.	D	0.66	HVBITB	MEMPR 83 (#238)	1.12	22.65	27.16	48.07	70.85	4.08				2.44	0.72	11.89				
COMOX	QUINS.COAL	QUINS.	1N MAIN + RDR	GOAT MEN E.	D	2.56	HVBITB	MEMPR 83 (#238)	0.99	22.41	25.38	51.30	73.05	4.27				1.78	0.51	12.53				
COMOX	QUINS.COAL	QUINS.	2	PIT #2 NORTH	P	3.61	HVBITC	MEMPR 83	1.16	11.39	37.21	47.23						0.88	0.66	9.74				
COMOX	QUINS.COAL	QUINS.	1 NTH.MAIN	PIT #1,2,3S	P	1.41	HVBITC	MEMPR 85	3.88	10.75	33.49	42.18						0.68		11.84				
COMOX	QUINS.COAL	QUINS.	1N MAIN + RDR	PIT #2 NTH	P	3.26	HVBITC	MEMPR 85	3.98	11.67	36.68	47.67						2.80						
COMOX	QUINS.COAL	QUINS.	1 STH MAIN	PIT #2 NTH	P	3.65	HVBITC	MEMPR 85	3.99	12.33	36.64	47.13						0.55						
COMOX	QUINS.COAL	QUINS.	1S MAIN + BASL	PIT #1,2,3S	P	3.21	HVBITC	MEMPR 83	3.13	14.58	35.54	46.75						0.57						
COMOX	QUINS.COAL	QUINS.	2	PIT #1,2,3S	P	4.68	HVBITC	MEMPR 83	2.97	21.65	32.98	42.40						1.21						
COMOX	QUINS.COAL	QUINS.	1 STH MAIN	PIT #1,2,3S	P	1.4	HVBITC	MEMPR 82	2.61	19.04	36.91	41.44						1.0						
COMOX	QUINS.COAL	QUINS.	1S MAIN + BASL	PIT #1,2,3S	P	3.21	HVBITC	MEMPR 82	2.72	20.64	35.08	41.40						5.66						
COMOX	QUINS.COAL	QUINS.	1 NTH MAIN	PIT #2, NTH	P	4.66	HVBITC	MEMPR 82	2.54	28.35	32.22	36.89						1.42						
NAN	WOLF MT.COAL	WOLF MT.	1 NTH	PREP PLANT	P	5.26	HVBITC	MEMPR 85	4.29	10.37	37.21	48.14						1.07						
NAN	WOLF MT.COAL	WOLF MT.	1	-	D	2.36	HVBITC	MEMPR 82 D	5.30	13.00	36.50	45.00	70.70	4.88				0.39						
NAN	WOLF MT.COAL	WOLF MT.	1	-	D	2.34	HVBITC	MEMPR 82 D	2.88	14.71	37.95	45.34	68.34	5.16	0.88		0.38	0.10	0.90	10.80		10880	80	
NAN	WOLF MT.COAL	WOLF MT.	1	-	D	2.34	HVBITC	MEMPR 82 D	2.25	14.89	36.93	45.93	71.71	5.57	0.05		0.57	0.62	1.29	9.66		12175	85	3
									2.81	10.32	39.09	48.58	72.89	5.24	0.26		0.70	0.96	1.39	9.20		12884	53	4

[1] Producing
[2] Developing

Table of abbreviations

COALFIELD NAME	ABBREVIATION	OPERATOR NAME	ABBREVIATION	AREA NAME	ABBREVIATION
Crowsnest	CRNT	Westar	WESTAR	Fording River Mine	FORDING R.M.
Elk Valley	ELK V.	Byron Ck. Collieries	BYRON CK. COLL.	Quintette	QUINT.
Peace River	PC. RIV.	Crowsnest Resources	CRNT. RES.	Bullmoose	BULLMS.
Telkwa	TLKW	Fording Coal Ltd.	FORDING COAL	Telkwa	TLKW
Comox	COMOX	Quintette Coal Ltd.	QUINT. COAL	Quinsam	QUINS.
Nanaimo	NAN	Teck Corp.	TECK CORP	Wolf Mountain	WOLF MT.
		Quinsam Coal Ltd.	QUINS. COAL		
		Wolf Mt. Coal Ltd.	WOLF MT. COAL		

APPENDIX IV (Continued)
ANALYSIS OF RAW COAL WITH FUEL POTENTIAL

COAL FIELD	OPERATOR	AREA	SEAM No.	SAMPLE SITE	STATUS	SEAM THICKNESS (metres)	ASTM RANK	DATA SOURCE	Ash Analysis %													Volatile Trace Element Analysis (ppm)			Ash Fusion Temperature °C (Reducing Atmosphere)			
									SiO_2	Al_2O_3	Fe_2O_3	TiO_2	P_2O_5	CaO	MgO	SO_3	Na_2O	K_2O	SrO	BaO	LOF	F	Cl	Hg	Initial	Softening	Hemi	Fluid
PC RIV	QUINT COAL	QUINT.	E	FRAMEMAC	P[1]	-	MVBIT	MEMPR 81 (061)	.	.	.	.	.	.	.	.	.	.	.	.	.	0.026	.	.	.	.	.	.
PC RIV	QUINT COAL	QUINT.	E	FRAMEMAC	P	-	MVBIT	MEMPR 81 (061)	.	.	.	.	.	.	.	.	.	.	.	.	.	0.022	.	.	.	.	.	.
PC RIV	QUINT COAL	QUINT.	E	FRAMEMAC	P	-	MVBIT	MEMPR 81 (061)	.	.	.	.	.	.	.	.	.	.	.	.	.	0.013	.	.	.	.	.	.
PC RIV	QUINT COAL	QUINT.	G	GRIZ/TRANS.	D[2]	3.7	-	MEMPR 86 (9724)	63.08	26.62	1.94	1.19	0.77	2.68	0.73	1.17	0.19	0.61	.	.	.	0.075	.	.	1480	1500	1500	1500
PC RIV	QUINT COAL	QUINT.	J & K1	GRIZ/TRANS.	D	7.13	-	MEMPR 86 (9724)	55.57	20.20	3.86	1.04	1.24	7.48	1.74	3.50	0.92	0.61	.	.	.	.	.	.	1345	1512	1537	1573
PC RIV	QUINT COAL	QUINT.	K	GRIZ/TRANS.	D	1.12	-	MEMPR 86 (9724)	60.85	17.35	3.12	1.28	0.98	2.82	1.22	3.64	0.54	0.43	.	.	.	.	.	.	1313	1415	1433	1463
PC RIV	QUINT COAL	QUINT.	QT-1	GRIZ/TRANS	D	6.3	-	MEMPR 86 (9724)	32.8	30.8	4.96	1.2	3.23	2.95	.39	.60	.	700	.	.	.	.	.	.	1280	1500	1500	1500
PC RIV	QUINT COAL	QUINT.	F	FRAMEMAC	P	-	MVBIT	MEMPR 81 (061)	.	.	.	.	.	.	.	.	.	.	.	.	.	0.009	.	.	.	.	.	.
PC RIV	QUINT COAL	QUINT.	E	FRAMEMAC	P	-	MVBIT	MEMPR 81 (061)	.	.	.	.	.	.	.	.	.	.	.	.	.	0.026	.	.	.	.	.	.
PC RIV	QUINT COAL	QUINT.	G	[illegible]LAND	D	-	SUBBITC	MEMPR 85 (9619)	.	.	.	.	.	.	.	.	.	.	.	.	.	0.027	.	.	.	.	.	.
PC RIV	QUINT COAL	QUINT.	A	FRAMEMAC	P	-	MVBIT	MEMPR 81 (061)	.	.	.	.	.	.	.	.	.	.	.	.	.	0.144	.	.	.	.	.	.
PC RIV	QUINT COAL	QUINT.	A	FRAMEMAC	P	-	MVBIT	MEMPR 81 (061)	.	.	.	.	.	.	.	.	.	.	.	.	.	0.168	.	.	.	.	.	.
PC RIV	QUINT COAL	QUINT.	D	FRAMEMAC	P	-	MVBIT	MEMPR 81 (061)	.	.	.	.	.	.	.	.	.	.	.	.	.	0.079	.	.	.	.	.	.
PC RIV	QUINT COAL	QUINT.	D	FRAMEMAC	P	-	MVBIT	MEMPR 81 (061)	.	.	.	.	.	.	.	.	.	.	.	.	.	0.052	.	.	.	.	.	.
PC RIV	QUINT COAL	QUINT.	D	FRAMEMAC	P	-	MVBIT	MEMPR 81 (061)	.	.	.	.	.	.	.	.	.	.	.	.	.	0.054	.	.	.	.	.	.
PC RIV	TECK CORP	BULLMS.	A-1	MINE SURF	P	-	MVBIT	CANMET 85	65.58	15.32	3.87	1.61	0.03	27.78	1.12	3.21	1.02	0.03	0.11	1.28	1.85	15.0	310.0	0.02	1210	1416	1462	1483
PC RIV	TECK CORP	BULLMS.	D	S. PORE	P	-	MVBIT	MEMPR 77 (9478)	67.74	24.07	1.39	1.24	0.39	0.70	0.79	0.59	0.65	1.98	.	.	.	.	.	.	1454	.	.	.
PC RIV	TECK CORP	BULLMS.	B	MINE SURF	P	-	MVBIT	CANMET 85	61.61	26.58	2.03	2.61	0.59	7.70	1.37	2.87	2.30	0.48	0.16	3.27	0.74	34.0	150.0	0.05	1253	1383	1543	1577
PC RIV	TECK CORP	BULLMS.	A1 & A2 COMP	S. PORE	P	-	MVBIT	MEMPR 77 (9478)	68.44	17.37	3.27	0.79	0.17	1.12	1.62	1.16	0.49	3.25	.	.	.	.	.	.	1283	1371	1393	1454
PC RIV	TECK CORP	BULLMS.	A1 & A2 & A SPLT	S. PORE	P	-	MVBIT	MEMPR 77 (9478)	71.68	14.48	3.35	0.84	0.16	1.01	1.39	0.47	0.40	3.02	.	.	.	.	.	.	1298	1393	1421	1457
TLKW	CRNT RES.	TLKW	3	GOAT HRN E.	D	2.18	HVBITB	MEMPR 83 (9230)	61.56	23.75	4.123	1.53	1.145	2.986	0.673	1.4	0.81	0.28	.	.	.	.	.	.	1401	1405	1409	1423
TLKW	CRNT RES.	TLKW	4	GOAT HRN E.	D	1.25	HVBITB	MEMPR 83 (9230)	63.16	19.19	7.008	1.085	1.9	3.5	0.635	1.53	0.785	0.15	.	.	.	.	.	.	1355	1399	1388	1396
TLKW	CRNT RES.	TLKW	2	GOAT HRN E.	D	2.39	HVBITB	MEMPR 83 (9230)	59.09	26.75	2.43	1.795	1.735	3.43	0.715	1.605	0.68	0.24	.	.	.	.	.	.	1454	1454	1454	1454
TLKW	CRNT RES.	TLKW	6	GOAT HRN E.	D	2.51	HVBITB	MEMPR 83 (9230)	60.96	27.40	2.36	1.58	1.17	1.99	0.55	0.82	0.97	0.42	.	.	.	.	.	.	1454	1454	1454	1454
TLKW	CRNT RES.	TLKW	7	GOAT HRN E.	D	1.45	HVBITB	MEMPR 83 (9230)	59.72	22.68	8.15	2.36	0.53	1.74	0.75	1.42	0.81	0.24	.	.	.	.	.	.	1454	1454	1454	1454
TLKW	CRNT RES.	TLKW	8	GOAT HRN E.	D	2.18	HVBITB	MEMPR 83 (9230)	50.72	26.46	9.72	2.42	0.69	2.94	1.33	2.48	0.92	0.30	.	.	.	.	.	.	1425	1454	1454	1454
TLKW	CRNT RES.	TLKW	9	GOAT HRN E.	D	1.52	HVBITB	MEMPR 83 (9230)	51.32	16.64	21.16	1.57	0.72	2.52	0.86	2.15	0.65	0.24	.	.	.	.	.	.	1345	1256	1278	1308
TLKW	CRNT RES.	TLKW	10	GOAT HRN E.	D	0.66	HVBITB	MEMPR 83 (9230)	67.46	12.49	9.72	1.44	0.82	2.94	0.82	2.15	0.57	0.24	.	.	.	.	.	.	1395	1411	1428	1454
TLKW	CRNT RES.	TLKW	5	GOAT HRN E.	D	2.56	HVBITB	MEMPR 83 (9230)	62.8	23.99	3.97	1.8	0.175	1.395	0.6	1.135	0.945	0.27	.	.	.	.	.	.	1452	1454	1454	1454
COMOX	QUINS. COAL	QUINS.	1N MAIN + RDR	PIT #2 NORTH	P	3.61	HVBITC	MEMPR 85	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.03	.	.	.	.	.
COMOX	QUINS. COAL	QUINS.	2	PIT #1,2,3S.	P	1.41	HVBITC	MEMPR 85	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.
COMOX	QUINS. COAL	QUINS.	1 NTH.MAIN	PIT #2 NTH	P	3.26	HVBITC	MEMPR 85	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.02	.	.	.	.	.
COMOX	QUINS. COAL	QUINS.	1N MAIN + RDR	PIT #2 NTH	P	3.65	HVBITC	MEMPR 85	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.
COMOX	QUINS. COAL	QUINS.	1 STH MAIN	PIT #1,2,3S	P	3.21	HVBITC	MEMPR 85	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.
COMOX	QUINS. COAL	QUINS.	1S MAIN + BASE	PIT #1,2,3S	P	4.68	HVBITC	MEMPR 85	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.
COMOX	QUINS. COAL	QUINS.	2	PIT #1,2,3S	P	1.4	HVBITC	MEMPR 82	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
COMOX	QUINS. COAL	QUINS.	1 STH MAIN	PIT #1,2,3S	P	3.21	HVBITC	MEMPR 82	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
COMOX	QUINS. COAL	QUINS.	1S MAIN + BASE	PIT #1,2,3S	P	4.68	HVBITC	MEMPR 82	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
COMOX	QUINS. COAL	QUINS.	1 NTH MAIN	PIT #2, NTH	P	3.26	HVBITC	MEMPR 83	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.02	.	.	.	.	.
COMOX	QUINS. COAL	QUINS.	1 NTH	PREP PLANT	P	-	HVBIT	SUBMISSION	37.40	20.10	9.50	1.40	0.70	25.00	0.50	4.10	0.20	0.20	.	.	.	0.04	0.04	.	1250	1300	1310	1330
NAN	WOLF MT COAL	WOLF MT.	1	-	D	2.24	HVBITC	MEMPR 82 D	40.71	22.21	2.92	0.84	0.16	18.59	2.83	3.02	0.48	0.07	.	.	.	.	.	.	1302	1317	1345	1498
NAN	WOLF MT COAL	WOLF MT.	1	-	D	2.24	HVBITC	MEMPR 82	43.98	19.47	3.78	0.80	0.63	3.24	3.34	0.52	0.01	.	.	.	.	.	.	.	1270	1297	1308	1351
NAN	WOLF MT COAL	WOLF MT.	1	-	D	2.24	HVBITC	MEMPR 82 D	32.77	14.63	5.66	0.60	0.50	25.60	3.95	6.47	0.35	0.55	.	.	.	.	.	.	1205	1225	1233	1246

[1] Producing
[2] Developing

Table of abbreviations

COALFIELD NAME	ABBREVIATION	OPERATOR NAME	ABBREVIATION	AREA NAME	ABBREVIATION
Crowsnest	CRNT	Westar	WESTAR	Fording River Mine	FORDING R.M.
Elk Valley	ELK V.	Byron Ck. Collieries	BYRON CK. COLL.	Quintette	QUINT.
Peace River	PC. RIV.	Crowsnest Resources	CRNT. RES.	Bullmoose	BULLMS.
Telkwa	TLKW	Fording Coal Ltd.	FORDING COAL	Telkwa	TLKW
Comox	COMOX	Quintette Coal Ltd.	QUINT. COAL	Quinsam	QUINS.
Nanaimo	NAN	Teck Corp.	TECK CORP	Wolf Mountain	WOLF MT.
		Quinsam Coal Ltd.	QUINS. COAL		
		Wolf Mt. Coal Ltd.	WOLF MT. COAL		

APPENDIX IV (Continued)
ANALYSIS OF RAW COAL WITH FUEL POTENTIAL

COAL FIELD	OPERATOR	AREA	SEAM No.	SAMPLE SITE	STATUS	SEAM THICKNESS (metres)	ASTM RANK	DATA SOURCE	Proximate Analysis %				Ultimate Analysis % (As Received Basis)								Calorific Value			
									MOIST	ASH	VOLATILE MATTER	FIXED CARBON	C	H	Sulphur Forms PY	SULPHATE	ORG	T.S	N	O	MJ/kg	BTU/lb	HGI	FSI
CRNT	WESTAR	MICHEL	10 (BALMER)	PREP PLANT	P[1]	-	MVBT	CANMET 85	1.77	24.41	19.34	54.45	64.51	3.63	0.13	0.02	0.19	0.34	0.12	4.31	25.35	10900	72	2.5
CRNT	WESTAR	HARMER	8	STOCK PILE	P	-	MVBT	CANMET 85	2.48	39.98	16.73	38.80	49.39	3.28	0.19	0.05	0.18	0.29	0.96	3.53	19.45	8361	62	1
CRNT	WESTAR	MICHEL UND	10 (BALMER)	-	P	-	LVBT	CANMET 84	1.80	15.29	16.39	66.52	75.49	4.00				0.25	1.05	1.59	30.12	12951	94	-
CRNT	WESTAR	HARM. SURF.	10 (BALMER)	ADIT #29 STH	P	-	LVBT	CANMET 84	1.02	14.32	18.27	66.39	75.48	3.96				0.27	1.52	3.43	30.36	13054	102	-
CRNT	WESTAR	HARM R MICH.	BALMER	-	P	-	MVBT	CANMET 79	4.8	12.9	19.8	62.3	75.4 *	4.0				0.3	1.1	5.6	28.4	12210	100	1.5
CRNT	WESTAR	HARM R MICH.	BALMER	-	P	-	MVBT	CANMET 79	6.0	21.5	17.7	54.8	67.5 *	3.5				0.3	1.0	4.8	24.8	10670	93	1.5
CRNT	WESTAR	HARMER	10 (BALMER)	MINE SURF	P	-	LVBT	CANMET 85	5.37	13.21	18.83	62.58	72.96	3.88	0.03		0.17	0.20	1.32	3.16	28.99	12466	112	2
CRNT	WESTAR (BARBER)	HARM R MICH.	BALMER	PREP PLANT	P	-	MVBT	CANMET 82	3.93	13.85	19.79	60.43	73.32*	3.76	0.07		0.24	0.31	1.26	4.85	28.31	12175	98	-
CRNT	BYRON CK COLL.	COAL MT.	MAMMOTH (M)	-	P	-	MVBT	CANMET 85	1.86	10.74	24.47	62.94	76.30	4.03	0.02		0.12	0.14	1.32	5.6	30.21	12990	77	1.5
CRNT	BYRON CK COLL.	COAL MT.	MAMMOTH (T)	-	P	-	MVBT	CANMET 85	2.22	16.85	23.69	63.26	75.77	3.91	0.02		0.14	0.16	1.30	3.81	30.10	12940	83	1
CRNT	BYRON CK COLL.	COAL MT/CRB.	MAMMOTH	PIT #34	P	-	MVBT	CANMET 85	2.12	22.20	22.04	53.56	64.17	3.61	0.05		0.15	0.20	1.1	6.55	25.29	10804	94	1.0
CRNT	BYRON CK COLL.	COAL MT.	MAMMOTH	PIT #3	P	-	MVBT	CANMET 84	2.60	18.26	21.79	58.11	69.67	3.59				0.19	0.95	5.10	27.61	11871	71	1.5
CRNT	BYRON CK COLL.	COAL MT.	MAMMOTH	-	P	-	MVBT	CANMET 84	5.06	15.02	21.07	58.85	69.61	3.61				0.19	1.04	5.21	26.12	11192	85	1
CRNT	BYRON CK COLL.	COAL MT.	MAMMOTH	PIT #3	P	-	MVBT	CANMET 85	3.09	14.37	23.00	59.54	71.78	3.88	0.04	0.01	0.14	0.19	1.35	5.42	28.39	12291	76	1.5
CRNT	BYRON CK COLL.	COAL MT.	MAMMOTH	PIT #11	P	-	MVBT	CANMET 79	3.4	17.2	21.0	54.4	72.0 *	3.8	0.3			0.3	1.1	3.1	27.4	11790	76	1.5
CRNT	BYRON CK COLL.	COAL MT.	MAMMOTH	PIT #11	P	-	MVBT	CANMET 79	3.7	14.0	22.0	60.3	74.2 *	4.1	0.2			0.2	1.1	5.8	28.6	12310	84	1.5
ELK V.	WESTAR	GRNHILLS MIN.	10	-	P	-	MVBT	CANMET 84	3.9	14.9	24.9	56.7	72.7 *	4.1	0.2			0.2	1.2	6.3	27.8	11965	90	2
ELK V.	CRNT.RES.	LINE CK MINE	8	MINE SURF	P	-	MVBT	CANMET 84	0.68	44.86	16.98	37.48	53.16	3.91				0.21	1.20	3.98	11.56	4970	78	
ELK V.	CRNT.RES.	LINE CK MINE	7	940 BENCH	P	-	MVBT	CANMET 85	0.89	26.56	18.90	53.65	63.76	3.55	0.099		0.30	0.39	0.89	3.79	25.45	10941	82	2.0
ELK V.	CRNT.RES.	LINE CK MINE	9	MINE SURF	P	-	MVBT	CANMET 85	1.24	23.49	20.10	55.18	65.54	3.78	0.08		0.26	0.43	1.25	4.27			79	2.0
ELK V.	CRNT.RES.	LINE CK MINE	8	-	P	-	LVBT	CANMET 85	1.94	20.01	16.42	52.62	60.80	3.35	0.05		0.27	0.31	0.87	3.73	24.21	10408	71	1.5
ELK V.	CRNT.RES.	LINE CK MINE	6	1025 BENCH	P	-	LVBT	CANMET 84	3.74	21.71	17.31	57.24	64.45	3.47				0.22	1.09	4.64	25.86	11120	70	
ELK V.	CRNT.RES.	LINE CK MINE	7	-	P	-	SBTB	CANMET 85	16.19	6.25	26.47	49.86	58.78	2.71	0.07		0.39	0.48	1.36	16.45	21.86	9399	135	
ELK V.	CRNT.RES.	LINE CK MINE	PREP PLANT	-	P	-	LVBT	CANMET 84	1.57	37.80	16.08	44.40	50.08	2.92				0.47	1.37	3.87	21.36	9182	98	
ELK V.	FORDING COAL	FORDING R.M.	10A	MINE SURF	P	-	MVBT	CANMET 85	2.65	18.54	19.07	59.73	68.6	3.58	0.07	?	0.17	0.23	1.05	5.35	27.05	11628	75	1.5
ELK V.	FORDING COAL	FORDING R.M.	13	MINE SURF	P	-	LVBT	CANMET 85	0.32	34.41	17.74	57.53	66.70	3.52	0.05		0.34	0.39	0.87	3.80	26.53	11407	71	1.0
ELK V.	FORDING COAL	FORDING R.M.	8	GRNHILLS S.	P	-	SBTA	CANMET 85	16.53	9.91	26.17	47.39	57.54	3.13	0.06	0.01	0.36	0.43	1.27	11.16	21.89	9411	121	-
ELK V.	FORDING COAL	FORDING R.M.	D	GRNHILLS S.	P	-	MVBT	CANMET 84	1.58	17.01	17.39	64.20	17.83	3.57				0.38	1.27	3.64	28.57	12283	79	-
ELK V.	FORDING COAL	FORDING R.M.	7	SURFACE	P	-	MVBT	CANMET 84	2.57	33.90	11.99	51.54	36.84	3.15				0.35	0.90	1.45	14.59	6273	67	-
ELK V.	FORDING COAL	FORDING R.M.	TAILINGS FD.	-	P	-	MVBT	CANMET 85	0.82	30.15	16.32	50.73	61.16	3.45	0.14	0.3	0.34	0.48	1.06	2.99	24.35	10961		
ELK V.	FORDING COAL	FORDING R.M.	12	EAGLE MTN	P	-	MVBT	CANMET 84	5.09	26.12	18.48	50.33	59.39	3.29				0.36	1.27	4.48	24.08	10552	134	2
ELK V.	FORDING COAL	FORDING R.M.	6	SURFACE	P	-	MVBT	CANMET 84	7.17	42.86	15.41	34.56	41.82	2.43				2.43	1.05	4.3	16.54	7712	76	2.5
ELK V.	FORDING COAL	FORDING R.M.	G	SURFACE	P	-	MVBT	CANMET 85	0.79	30.03	19.05	49.34	59.12	3.51	0.07		0.42	0.49	0.95	4.58	25.35	10627	73	2
ELK V.	FORDING COAL	FORDING R.M.	11	EAGLE MTN	P	-	MVBT	CANMET 85	1.36	13.72	22.63	62.27	73.49	4.41	0.08	0.01	0.32	0.41	1.58	4.81	30.05	12930	106	-
PC.RIV.	QUINT.COAL	QUINTETTE	F	GRIZ/TRANS	D[2]	3.53	MVBT	MEMPR 86 (9724)	0.78	5.26	27.76	59.20	69.33	4.00				0.77	1.73	9.91	27.72	11914	97	-
PC.RIV.	QUINT.COAL	QUINTETTE	D	GRIZ/TRANS.	D	-	-	MEMPR 86 (9724)	0.50	19.35	19.41	60.8						0.49					87	
PC.RIV.	QUINT.COAL	QUINTETTE	J	SHRANO	D	-	HVBITC	MEMPR 86 (9734)	0.46	17.78	20.86	60.0						1.88					83	
PC.RIV.	QUINT.COAL	QUINTETTE	O	SHRANO	D	-	SBITC	MEMPR 85 (9619)	0.65	22.96	17.94	58.0						0.26				13070	79	2.4
PC.RIV.	QUINT.COAL	QUINTETTE	F	FRAME&4C	P	-	MVBT	MEMPR 85 (9619)	0.60	40.15	14.03	44.0						0.35				9910	69	2.9
								MEMPR 81 (901)	0.78	21.53	20.43	57.26						0.55					79	4

[1]Producing
[2]Developing

Table of abbreviations

COALFIELD NAME	ABBREVIATION
Crowsnest	CRNT
Elk Valley	ELK V.
Peace River	PC. RIV.
Telkwa	TLKW
Comox	COMOX
Nanaimo	NAN

OPERATOR NAME	ABBREVIATION
Westar	WESTAR
Byron Ck. Collieries	BYRON CK. COLL.
Crowsnest Resources	CRNT. RES.
Fording Coal Ltd.	FORDING COAL
Quintette Coal Ltd.	QUINT. COAL
Teck Corp.	TECK CORP
Quinsam Coal Ltd.	QUINS. COAL
Wolf Mt. Coal Ltd.	WOLF MT. COAL

AREA NAME	ABBREVIATION
Fording River Mine	FORDING R.M.
Quintette	QUINT.
Bullmoose	BULLMS.
Telkwa	TLKW
Quinsam	QUINS.
Wolf Mountain	WOLF MT.

APPENDIX IV (Continued)
ANALYSIS OF RAW COAL WITH FUEL POTENTIAL

COAL FIELD	OPERATOR	AREA	SEAM No.	SAMPLE SITE	STATUS	SEAM THICKNESS (metres)	ASTM RANK	DATA SOURCE	Ash Analysis %													Volatile Trace Element Analysis (ppm)			Ash Fusion Temperature °C (Reducing Atmosphere)			
									SiO_2	Al_2O_3	Fe_2O_3	TiO_2	P_2O_5	CaO	MgO	SO_3	Na_2O	K_2O	SrO	BaO	LOF	F	Cl	Hg	Initial	Softening	Hemi	Fluid
CRNT	WESTAR	MICHEL	10 (BALMER)	PREP PLANT	P[1]	-	MVBT	CANMET 85	63.50	23.25	2.77	1.29	0.34	1.30	0.52	1.10	0.08	1.44	0.22	0.26	0.88	-	-	0.05	1482	1482	1482	1482
CRNT	WESTAR	HARMER	8	STOCK PILE	P	-	LVBT	CANMET 85	65.45	24.85	1.71	1.25	0.26	0.64	0.72	0.54	0.06	1.94	0.05	-	1.05	-	-	0.07	1482	1482	1482	1482
CRNT	WESTAR	MICHEL UND.	10 (BALMER)	-	P	-	LVBT	CANMET 84	60.69	27.68	3.59	1.27	0.74	2.37	0.25	1.61	0.13	0.68	0.02	-	0.19	-	-	0.05	1441	1482	1482	1482
CRNT	WESTAR	HARM. SURF.	10 (BALMER)	ADIT #29 STH	P	-	LVBT	CANMET 84	60.55	27.79	2.45	1.44	1.16	2.46	0.19	0.92	0.10	0.82	0.05	-	0.17	-	-	0.02	1471	1482	1482	1482
CRNT	WESTAR	HARM R MICH.	BALMER	-	P	-	MVBT	CANMET 79	61.2	29.6	2.6	1.7	0.8	2.4	0.7	1.7	-	0.4	-	-	-	-	-	0.09	1482	1482	1482	1482
CRNT	WESTAR	HARM R MICH.	BALMER	-	P	-	MVBT	CANMET 79	60.0	25.5	2.3	1.5	0.4	1.1	0.4	0.4	1.0	1.2	-	-	-	-	-	0.08	1482	1482	1482	1482
CRNT	WESTAR	HARMER	10 (BALMER)	MINE SURF.	P	-	LVBT	CANMET 85	57.46	32.90	0.92	1.95	0.09	0.77	0.36	0.43	0.04	0.15	0.02	0.09	4.20	63.0	79.0	0.05	1482	1482	1482	1482
CRNT	WESTAR (KAISER)	HARM R. MICH.	BALMER	PREP PLANT	P	-	MVBT	CANMET 82	56.57	29.16	5.62	1.75	0.97	1.89	0.70	0.53	0.05	0.95	0.08	0.10	0.44	-	-	-	1480	1480	1480	1480
CRNT	BYRON CK. COLL.	COAL MT.	MAMMOTH (M)	-	P	-	MVBT	CANMET 85	39.25	27.11	3.78	1.95	0.16	15.92	3.70	4.61	1.05	0.89	0.17	0.77	1.17	26.0	50.0	0.05	1355	1357	1436	1446
CRNT	BYRON CK. COLL.	COAL MT.	MAMMOTH (B)	-	P	-	MVBT	CANMET 85	42.05	28.98	3.04	1.90	0.25	13.89	2.44	4.44	1.04	0.13	0.26	0.80	1.49	42.0	70.0	0.04	1390	1407	1410	1448
CRNT	BYRON CK. COLL.	COAL MT.	MAMMOTH (T)	-	P	-	MVBT	CANMET 85	52.57	36.05	1.65	1.78	0.23	1.53	0.80	1.37	0.34	0.26	0.09	0.26	1.75	97	70.0	0.07	1482	1482	1482	1482
CRNT	BYRON CK. COLL.	COAL MT.#3 E/B	MAMMOTH	PIT #34	P	-	MVBT	CANMET 84	54.84	25.17	1.63	1.18	0.08	11.01	0.72	2.97	0.31	0.42	0.16	0.75	0.85	-	-	0.08	1333	1379	1402	1454
CRNT	BYRON CK. COLL.	COAL MT.	MAMMOTH	PIT #3	P	-	MVBT	CANMET 84	51.00	30.55	3.00	1.85	-	4.19	2.08	3.53	0.33	0.35	0.04	-	0.54	-	-	0.05	1446	1482	1482	1482
CRNT	BYRON CK. COLL.	COAL MT.	MAMMOTH	-	P	-	MVBT	CANMET 85	48.4	25.01	3.44	1.94	0.09	9.95	3.17	4.22	1.01	0.10	0.25	0.85	0.91	114.0	60.0	0.04	1263	1296	1377	1429
CRNT	BYRON CK. COLL.	COAL MT.	MAMMOTH	PIT #3	P	-	MVBT	CANMET 79	49.4	28.9	3.0	1.8	0.7	7.5	1.2	3.0	0.5	0.4	-	-	-	-	-	0.08	-	-	-	-
CRNT	BYRON CK. COLL.	COAL MT.	MAMMOTH	PIT #11	P	-	MVBT	CANMET 79	54.2	35.0	2.4	2.1	0.5	1.5	1.2	1.5	0.5	0.5	-	-	-	-	-	0.08	-	-	-	-
CRNT	BYRON CK. COLL.	COAL MT.	MAMMOTH	PIT #11	P	-	MVBT	CANMET 79	46.2	34.4	2.5	2.0	0.6	0.7	1.1	2.7	0.6	0.2	-	-	-	-	-	0.07	-	-	-	-
ELK V	WESTAR	GRNHILLS MIN	10	-	P	-	MVBT	CANMET 84	69.94	20.02	2.36	0.97	0.11	0.88	0.30	0.69	0.09	3.27	0.01	-	0.03	-	-	0.07	1360	1482	1482	1482
ELK V	CRNT RES.	LINE CK MINE	8	MINE SURF.	P	-	MVBT	CANMET 85	62.37	25.12	0.91	1.37	2.08	2.98	0.38	-	0.09	1.79	0.04	0.19	0.53	301.0	40.0	0.11	1402	1482	1482	1482
ELK V	CRNT RES.	LINE CK MINE	7	946 BENCH	P	-	MVBT	CANMET 85	61.2	27.55	3.05	1.61	1.50	1.81	0.59	0.46	0.07	1.20	0.08	0.40	0.07	345.0	40.0	0.04	1482	1482	1482	1482
ELK V	CRNT RES.	LINE CK MINE	9	MINE SURF.	P	-	LVBT	CANMET 85	72.88	23.41	0.61	1.47	-	0.88	0.58	0.04	0.05	0.55	0.01	0.16	0.12	79.0	40.0	0.06	1482	1482	1482	1482
ELK V	CRNT RES.	LINE CK MINE	8	-	P	-	LVBT	CANMET 84	61.96	30.37	1.66	1.41	0.30	0.66	0.32	0.38	0.04	1.50	0.02	-	0.34	-	-	0.06	1482	1482	1482	1482
ELK V	CRNT RES.	LINE CK MINE	4	1825 BENCH	P	-	SBTB	CANMET 85	47.68	30.38	3.85	1.43	0.71	7.60	1.51	4.90	0.06	0.22	0.21	0.38	0.75	95.0	30.0	0.04	1371	1457	1477	1482
ELK V	CRNT RES.	LINE CK MINE	7	-	P	-	LVBT	CANMET 84	66.38	26.27	1.51	1.39	0.13	0.50	0.15	0.35	0.05	1.64	0.01	-	0.05	-	-	0.04	1482	1482	1482	1482
ELK V	CRNT RES.	LINE CK MINE	PREP PLANT	-	P	-	MVBT	CANMET 85	57.38	31.81	3.48	1.52	0.68	1.01	0.43	0.15	0.11	0.95	0.04	0.24	0.66	169.0	30.0	0.09	1482	1482	1482	1482
ELK V	CRNT RES.	LINE CK MINE	10A	MINE SURF.	P	-	LVBT	CANMET 85	66.27	25.66	0.55	1.51	0.23	0.24	0.12	-	0.02	0.38	0.04	0.30	3.15	79.0	40.0	0.04	1482	1482	1482	1482
ELK V	FORDING COAL	FORDING R.M.	13	MINE SURF.	P	-	SBTA	CANMET 85	35.93	20.11	7.79	1.14	0.84	18.91	2.36	15.08	0.08	0.83	0.18	0.77	1.99	96.0	40.0	0.05	1255	1297	1371	1477
ELK V	FORDING COAL	FORDING R.M.	8	GRNHILLS S.	P	-	MVBT	CANMET 84	60.43	20.95	5.64	0.92	1.85	4.08	0.97	1.89	0.02	1.30	0.05	-	0.52	-	-	0.04	1346	1377	1439	1460
ELK V	FORDING COAL	FORDING R.M.	D	GRNHILLS S.	P	-	MVBT	CANMET 84	71.40	19.36	1.91	0.98	0.10	0.40	0.95	0.29	0.07	2.85	0.02	-	0.13	-	-	0.06	1427	1463	1482	1482
ELK V	FORDING COAL	FORDING R.M.	7	SURFACE	P	-	MVBT	CANMET 85	68.05	23.90	1.36	1.07	0.04	0.07	0.01	0.51	0.09	2.51	0.07	0.23	0.49	207.0	30.0	0.07	1482	1483	1483	1482
ELK V	FORDING COAL	FORDING R.M.	TAILINGS PD.	-	P	-	MVBT	CANMET 84	63.67	22.76	0.72	1.20	0.37	1.82	0.49	1.08	0.05	1.80	0.02	-	0.43	-	-	0.04	1227	1424	1474	1482
ELK V	FORDING COAL	FORDING R.M.	12	EAGLE MTN.	P	-	MVBT	CANMET 84	68.75	18.47	3.47	.97	.4	1.41	.66	1.13	.04	3.17	0.01	-	0.47	-	-	.06	1321	1471	1482	1482
ELK V	FORDING COAL	FORDING R.M.	8	SURFACE	P	-	MVBT	CANMET 85	59.78	33.64	1.50	1.47	0.11	0.16	-	-	0.04	1.68	0.05	0.23	0.83	148.0	40.0	0.05	1482	1482	1482	1482
ELK V	FORDING COAL	FORDING R.M.	G	SURFACE	P	-	MVBT	CANMET 85	64.51	23.03	5.74	1.35	1.36	1.71	0.43	-	0.09	1.20	0.15	0.28	0.32	201.0	40.0	0.05	1229	1435	1466	1482
ELK V	FORDING COAL	FORDING R.M.	11	EAGLE MTN.	P	-	MVBT	CANMET 84	49.18	21.05	1.56	1.22	0.70	9.16	1.29	12.19	0.13	1.95	0.13	-	1.32	-	-	0.02	1260	1310	1371	1429
PC RIV	QUINT COAL	QUINTETTE	F	GRIZ/TRANS	D[2]	3.52	MVBT	MEMPR 86 (9724)	52.86	27.03	3.41	1.28	3.03	5.80	1.08	2.85	0.35	0.89	-	-	0.121	-	-	-	1312	1405	1432	1472
PC RIV	QUINT COAL	QUINTETTE	D	GRIZ/TRANS	D	-	-	MEMPR 86 (9724)	53.90	31.69	3.21	1.68	2.60	5.51	0.72	2.59	0.19	0.27	-	-	-	-	-	-	1470	1500	1500	1500
PC RIV	QUINT COAL	QUINTETTE	J	SMILANO	D	-	HVBITC	MEMPR 85 (9619)	-	-	-	-	-	-	-	-	-	-	-	-	0.032	-	-	-	-	-	-	-
PC RIV	QUINT COAL	QUINTETTE	G	SMILANO	D	-	SBITC	MEMPR 85 (9619)	-	-	-	-	-	-	-	-	-	-	-	-	0.027	-	-	-	-	-	-	-
PC RIV	QUINT COAL	QUINTETTE	F	FRAME/86eC	P	-	MVBT	MEMPR 81 (981)	-	-	-	-	-	-	-	-	-	-	-	-	0.017	-	-	-	-	-	-	-

[1]Producing
[2]Developing

Table of abbreviations

COALFIELD NAME	ABBREVIATION	OPERATOR NAME	ABBREVIATION	AREA NAME	ABBREVIATION
Crowsnest	CRNT	Westar	WESTAR	Fording River Mine	FORDING R.M.
Elk Valley	ELK V.	Byron Ck. Collieries	BYRON CK. COLL.	Quintette	QUINT.
Peace River	PC. RIV.	Crowsnest Resources	CRNT. RES.	Bullmoose	BULLMS.
Telkwa	TLKW	Fording Coal Ltd.	FORDING COAL	Telkwa	TLKW
Comox	COMOX	Quintette Coal Ltd.	QUINT. COAL	Quinsam	QUINS.
Nanaimo	NAN	Teck Corp.	TECK CORP	Wolf Mountain	WOLF MT.
		Quinsam Coal Ltd.	QUINS. COAL		
		Wolf Mt. Coal Ltd.	WOLF MT. COAL		